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KEY TO PRONUNCIATION.

ä	far, father
ā	fate, hate
a or ă	at, fat
ã	air, care
ạ	ado, sofa
â	all, fall
ch	choose, church
ē	eel, we
e or ĕ	bed, end
ė	her, ovẹr: also Fr. *e*, as in *de; eu*, as in *neuf;* and *oeu*, as in *boeuf, coeur;* Ger. *ö* (or *oe*), as in *ökonomie.*
ẹ	befall, elope
ē	agent, trident
ff	off, trough
g	gas, get
gw	anguish, guava
h	hat, hot
h or ʜ	Ger. *ch*, as in *nicht, wacht*
hw	what
ī	file, ice
i or ĭ	him, it
î	between e and i, mostly in Oriental final syllables, as, Ferîd-ud-din
j	gem, gẹnius
kw	quaint, quite
ṅ	Fr. nasal *m* or *n*, as in *embonpoint, Jean, temps*

ñ	Span. *ñ*, as in *cañon* (căn′yŏn), *piñon* (pēn′yŏn)
ng	mingle, singing
nk	bank, ink
ō	no, open
o or ŏ	not, on
ô	corn, nor
ȯ	atom, symbol
ọ	book, look
oi	oil, soil; also Ger. *eu*, as in *beutel*
ō or oo	fool, rule
ou or ow	allọw, bowsprit
s	satisfy, sauce
sh	show, sure
th	thick, thin
ŧh	father, thither
ū	mute, use
u or ŭ	but, us
u̇	pull, put
ü	between u and e, as in Fr. *sur*, Ger. *Müller*
v	of, very
y	(consonantal) yes, young
z	pleasant, rose
zh	azure, pleasure

′ (prime), ″ (secondary) accents, to indicate syllabic stress

THE AMERICANA

Enemata, fluid substances passed into the rectum and large intestine for cleansing, for medication, or for nutrient purposes. For the treatment of chronic constipation, enemata of cold or hot water, water and soapsuds, water and glycerine, are found to be of great service. Almost any remedial substance capable of solution and absorption may be placed in the rectum or large intestine to affect the parts locally or to exert a general action on the body. Almost all remedies that are taken into the stomach may be taken by means of enemata. The dose has to be somewhat larger in most instances. For the treatment of pinworms, diarrhœa, and dysentery enemata are invaluable. In medicine the lower bowel may be used much oftener than it is. In acute colicky pains from «wind» in the bowels there is nothing better, as a rule, than a hot enema of at least two quarts, at a temperature of from 116° to 118° F. As the lower bowel is not provided with digestive juices, when nutrient enemata are to be given the insoluble food-substances should be so converted as to render them capable of absorption — hence all gruels, eggs, milk, etc., to be used should first be predigested by peptic or pancreatic ferments. A special form of enema, consisting of hot (116° to 118° F.) salt solution (1 teaspoonful of salt to 1 pint of water), allowed to pass in and out of the bowel slowly and made to ascend some distance, is of immense service in cases of surgical shock, in profuse bleeding, and in cases in which the kidneys refuse to secrete urine. This is termed enteroclysis (q.v.). Enemas for cleansing the bowel should be copious; those for nutrient purposes should be small — not over half an ounce.

Enemy. See War, Laws of.

Energumen, ĕn-ĕr-gū'mĕn, a person controlled or "worked up" (ἐνεργούμενος) by evil spirits. The word is in common use in the writings of the Greek and Latin fathers: it is equivalent to the (δαιμονιζόμενος) (possessed by a devil) of the New Testament. In the 3rd century the churches kept registers of their energumens and dealt with them much as though they were lepers: they were supported by the alms of the faithful and lodged in dwellings near the churches; so we learn from the acts of the Council of Orange 529 (*Concilium Arausicanum*). See Exorcism.

E'nergy, in physics and theoretical mechanics, that attribute of a body, or of a material system, by virtue of which the body or system can do work; work being simultaneously defined as the overcoming of resistance through distance. A raised weight can do work by falling to the ground; a coiled spring can do work in unwinding; a mass of compressed air can do work in expanding down to the normal atmospheric pressure; and similar examples might be multiplied indefinitely. All of these bodies, or systems, that can do work by changing their position, or their shape, or their state, are said to possess «energy»; and the energy that a body possesses is measured strictly by the quantity of work that it can do. The unit that is adopted in the measurement of work depends upon the nature of the problem that is under consideration. In modern scientific investigations the unit of work is commonly the erg, which is defined as the work that is done in overcoming a resistance of one dyne, through a distance of one centimetre. In ordinary engineering operations, the unit of work commonly employed (at least in the United States and in England) is the foot-pound, which is defined as the amount of work that is done in overcoming a resistance of one pound, through a distance of one foot. The foot-pound is not as precise and definite a unit as the erg, because the attraction that the earth exerts upon a pound of matter varies with the latitude and with the elevation above the sea, and hence the foot-pound varies in the same manner. The variation is not great enough, however, to destroy the usefulness of the foot-pound as a unit of work in ordinary engineering operations, and hence this familiar unit is not likely to be superseded, for ordinary purposes, unless the metric system is brought into general use in the United States. There is no great difficulty in understanding that a weight can do only a definite amount of work in falling from one level to another, or that a spring can do only a definite amount of work in unwinding; for we all know that clocks have to be wound up regularly, and that a small waterfall will not yield the same power as a big one that has the same difference of level between its top and its bottom. In the case of a body that falls freely through the air, however, the fact that the energy that it had in virtue of its elevated position is not lost is not so evident. It is true that the energy, in this case, is not immediately expended in overcoming frictional resistance, nor in doing work of any obvious and visible kind. Nevertheless it is not lost; for it is expended in giving the moving body its velocity. A moving body possesses energy in virtue of its motion, and work must be done by it before it will stop. Thus a railroad train, moving at high speed, cannot be brought to rest at once, because the energy of motion that it possesses must first be expended in overcoming the resistance of the brakes, or the natural frictional resistance of its axles in their journals and its wheels upon the tracks. The energy that a body possesses in virtue of its motions is called «kinetic energy,» that which it possesses on account of its position, or its state of strain, being called «potential energy,» by way of distinction. The amount of work that must be done upon a body of mass M, which is moving with a speed V, in order to bring it to rest (that is, its «kinetic energy»), can easily be shown to be given by the formula Kinetic Energy $= \frac{1}{2} MV^2$.

The conversion of kinetic energy into potential energy and back again, is well illustrated in the pendulum. At the lowest point of its swing, the energy of a pendulum is entirely kinetic; while at the highest point of the swing, and just as the motion is about to be reversed, the energy is entirely potential.

Conservation of Energy.— The physical law that is known by this name merely asserts that the total amount of energy in any isolated system is absolutely invariable in amount. Energy may be added from without, or abstracted in a similar manner; but so long as no external influences are permitted to interfere, the total quantity of energy within the system is incapable of either increase or diminution. In the case of the pendulum this is easily admitted; but other systems are easily imagined, in which the truth of the law is by no means obvious. For example, a tightly-wound watch-spring possesses potential energy, in virtue of which it may be caused to drive a train of wheels, and to do work. But suppose the coiled watch-spring is dissolved in an acid, and meanwhile secured in some manner so that it cannot unwind. We cannot assume that the solution that is ultimately obtained is any different, whether the watch-spring was coiled before dissolving, or not. What becomes of the energy in the spring? This question would be best answered by experiment; but in the absence of experimental data the conjecture may be reasonably made that the two sides of the spring, being in different states of strain, act like plates of different metals when immersed in the acid, and give rise to electric currents through the liquid, whose combined chemical and thermal effects correspond precisely to the potential energy that was stored in the spring by winding. The simpler case of a body falling freely through the air is also somewhat confusing at first thought, because although it may be admitted that the potential energy is stored up by accelerating the body while it is falling, it is by no means evident that the energy is not annihilated as soon as the body strikes the ground. As a matter of fact, the energy of the falling body is converted into heat when the visible motion is suddenly arrested, and the body and the ground immediately around it are warmed by an amount that corresponds precisely to the kinetic energy that the body had immediately before the arrest. This explanation is not merely speculative, for it rests upon sound experimental evidence. The arrest of a cannon-ball is accompanied by the generation of enormous quantities of heat, and the woodwork on battle-ships is often set afire in consequence of the mere impact of projectiles. The water at the bottom of a waterfall is measurably warmer than that at the top; and the rise in temperature that is observed when a falling mass of lead is suddenly arrested was used by Hirn with remarkable success for the determination of the mechanical equivalent of heat.

The idea that energy cannot be created appears to have been familiar to Galileo, who inferred the fact from a careful study of the simple machines that were in use in his day. There appeared to be many cases in which energy is destroyed, however, and the indications were, in fact, that all mechanical energy is gradually wasted away by frictional losses and by others of like nature. In cases in which these losses do not exist, or are negligible, the idea of the conservation of the energies of a system, and of the perpetual transformations of kinetic energy into potential energy and the reverse, proved to be of the greatest service in simplifying the theoretical discussion of many problems in mechanics, even before the modern theory of heat was formulated. The motions of the celestial bodies, for example, are much more easily described by the aid of the principle of conservation of energy than they could be without it. The extension of that principle so as to cover all the cases in which it had previously appeared to be violated could not be made until the fact was recognized that heat is not a substance; for, obviously, it was impossible that a substance could be converted into mechanical energy. In the first years of the 19th century Rumford made experiments tending to prove that heat is not a substance, and he appears to have been convinced, in his own mind, of the correctness of his novel views. A quarter of a century later Carnot appears to have reached the same conclusion, if we may judge from the note-book that he left among his papers. It was not until about 1840, however, that the great steps were taken that led to the establishment of our present views. Several eminent names are connected with these beginnings of the modern theory of heat, and it is difficult to apportion the credit among them justly. Prominent among these names are those of Séguin, Mayer, Colding, and Joule; but it is undoubtedly to Mayer and Joule that we are chiefly indebted for the new ideas, and controversy has been mainly confined to the discussion of the priority and the relative importance of the contributions of these two men.

Dr. Julius Robert Mayer, an obscure physician of Heilbronn, Germany, who had had some professional experience in the island of Java, had observed that the venous blood of the Javanese often exhibits the brilliant red color that is commonly observed only in the highly oxygenated blood of the arterial circulation; and after much reflection he came to the conclusion that this is because a lesser amount of oxidation suffices to maintain the temperature of the body in a hot climate than would be required in a cooler one. These observations were made in the summer of 1840. In May, 1842, he published, in Liebig's 'Annalen,' a paper entitled 'Remarks on the Forces of Inorganic Nature,' in which he gave a preliminary account of his discovery. Here he presents the general outline of the new theory very clearly, and the grasp of the subject that he displays at this early date is truly wonderful. The locomotive itself was then a great novelty, but he uses it to illustrate the transformation of heat into mechanical energy and back again in the following sentence, which would be a credit to the most advanced physicist of to-day: «Our locomotives may be compared to distilling apparatus; the heat beneath the boiler passes into the motion of the train, and is again deposited as heat in the axles and wheels.» In 1845 he published a second and much more remarkable paper entitled 'Organic Motion in its Connection with Nutrition,' in which he gives a detailed calculation of the mechanical equivalent of heat, from the known specific heats of air.

The contributions of James Prescott Joule, of Manchester, England, to the mechanical theory of heat and the conservation of energy were the natural outcome of investigations that he had been making upon the heating effects of electric currents. His first paper that distinctly enunciated the new conception of heat as a form of energy was read at Cork, in 1843, before the British Association, and was entitled 'On the Calorific Effects of Magneto-Electricity, and on the Mechanical Value of Heat.' As first written it was very involved, and Faraday, who appears to have failed to grasp its exceeding importance, advised Joule not to submit it. He did submit it, however, and in it he gave a number of estimates of the mechanical equivalent of heat. The paper apparently did not greatly impress either the British Association or the outside world; for when Joule brought the subject up again before the same association in 1847 he had an experience that is best described in his own words: "The chairman suggested that, as the business of the section pressed, I should not read my paper, but confine myself to a short verbal description of my experiments. This I endeavored to do, and discussion not being invited, the communication would have passed without comment if a young man had not risen in the section, and by his intelligent observations created a lively interest in the new theory." The young man was Lord Kelvin, then simply William Thomson, two years out of college. In later years Joule obtained far better values for the mechanical equivalent of heat, and spent much of his time devising and executing new methods for its determination.

In England and the United States Joule is commonly credited with the discovery of the true nature of heat; but in Europe the honor is given to Mayer. Tyndall compares the two very fairly. "Withdrawn from mechanical appliances," he says, "Mayer fell back upon reflection, selecting with marvelous sagacity, from existing physical data, the single result on which could be founded a calculation of the mechanical equivalent of heat. In the midst of mechanical appliances, Joule resorted to experiment, and laid the broad and firm foundation which has secured for the mechanical theory the acceptance it now enjoys. A great portion of Joule's time was occupied in actual manipulation; freed from this, Mayer had time to follow the theory into its most abstruse and impressive applications. With their places reversed, however, Joule might have become Mayer, and Mayer might have become Joule."

In 1847 Hermann Helmholtz published his remarkable paper entitled 'On the Conservation of Energy,' in which the subject was presented with great generality and clearness, and which had a profound influence in spreading the new doctrine which taught that no energy is ever created or annihilated, but that we have to do merely with endless transformations of it from one form into another. Attempts have been made to deduce the principle of the conservation of energy from the general laws of mechanics, and in many special cases these attempts have been successful, though they cannot be in all cases, because systems are easily imagined in which the law is not fulfilled. The point is, however, that these imaginary, non-conservative systems apparently do not exist in nature. In allusion to the two-fold nature of the subject (that is, the mathematical and physical aspects), it has been humorously said that everybody now believes firmly in the conservation of energy, because the mathematicians believe it to be a fact of observation, while the physicists believe it to be a theorem in mathematics. It is now generally admitted, however, to be a fact of observation, whose truth or falsity is to be established by experiment. Helmholtz proved that in any system composed of particles moving about in paths or orbits, and subjected only to "central forces" (that is, to forces that act always toward fixed centres or foci, or which act, between every pair of particles, along the line adjoining their centres), the energy must be conserved, if the ordinary laws of theoretical mechanics hold true for the motions of the particles of which the system consists. Hence, if it be admitted that all matter consists of atoms that act upon one another only by forces that are central, a long step has been taken toward proving the law for all material systems. Unfortunately, however, we are not sure that central forces are the only ones that act upon the atom. It is an interesting fact that it was the study of the processes of organic nature that gave Mayer his first inspiration concerning the true nature of heat, and yet it is precisely here that the only doubt as to the entire generality of the law of conservation now exists. The most general test that can be applied to a system to enable us to judge from theoretical considerations whether it is conservative or not, is this: Let the system be protected from external influences, and then, at a given instant, conceive the motion of every one of its particles to be precisely reversed in direction, without being modified in any other way. If, when left to itself, the system would then retrace its previous history so that the events of that history would recur in reverse order, the conservation of energy is rigorously fulfilled in it. If, on the other hand, the system would not so retrace its history, we cannot affirm that it is conservative, but must test the point by a direct appeal to experiment. Now, although this crucial condition of reversibility is frequently (and probably universally) fulfilled in inorganic nature, we certainly cannot assert it to be true in connection with living matter, not even with respect to the meanest fungus. Hence we cannot, from reasoning based on the inorganic world alone, draw any sound conclusion whatever about the conservation of energy in the organic changes that occur in living tissues. To reach such conclusions for the living animal, we must weigh and analyze the food administered and the excreta given off; we must determine the oxygen absorbed and the carbon dioxide and other products exhaled; and we must measure the heat given out, and the external work performed. When these things have been weighed, measured, and analyzed for a sufficient period and with the necessary precision, then, and then only, shall we be competent to affirm or deny the truth of the conservation of energy in the animal machine. Such data are difficult to obtain, but much has been done in this direction, and while we are not yet prepared to establish the fact, beyond controversy, that energy is conserved in the animal body, all the data that we have point to this conclusion, and it is now commonly admitted to be true. Consult: Stewart, 'The Conservation of Energy.' See PERPETUAL MOTION; THERMODYNAMICS.

Energy, Conservation of. See ENERGY.

Eneuresis, a symptom of many diseases of the bladder resulting in incontinence or involuntary passage of urine. It is a prevalent malady of childhood and only becomes of importance after the period of infancy, when the child should have learned to control the bladder. The control of the bladder is in part a matter of conscious effort, and has its representation in the higher brain-centres. Bladder-control is also exercised by that portion of the sympathetic nervous system found in the solar and sacral plexuses, and likewise in a number of cells in the spinal cord, situated in the lumbar region. Interference with the action of any or all of these centres may result in eneuresis. Disease of the spinal cord may cause excessive irritation of the sympathetic nervous system, and may result in nocturnal eneuresis; and the cutting off of the cerebral control may also bring about this condition. During deep sleep the cerebral control is usually cut off, accounting thus for the prevalence of eneuresis in deep sleep in children. Very frequently the immediate cause of eneuresis is some form of local irritation. This is particularly prevalent in young girls, and should always be removed, if possible, in the treatment. Drug medication is extremely unsatisfactory for this condition. The most efficient measures consist in building up the general nervous system of the patient by tonics, cold baths, and exercise in the open air.

Enfantin, ŏṅ-fŏṅ-tăṅ, **Barthélemy Prosper,** French socialist of the Saint Simon school: b. Paris 8 Feb. 1796; d. there 31 Aug. 1864. After the July revolution of 1830 Enfantin associated himself with Bazard for the active propagation of Saint-Simonism. Bazard expounded it in its relations to philosophy and politics; Enfantin mainly in its relations to the social state. Soon, however, a schism broke out between the two on the question of marriage and the relation of the sexes, for his views on which Enfantin was, in 1832, sentenced to two years' imprisonment and to pay a fine of 100 francs. Being released at the expiration of a few months, he went to Egypt. He was subsequently appointed a member of the scientific commission for Algiers, and on his return from Africa wrote ‹Colonization of Algeria› (1843). After the revolution of 1848 he edited the journal ‹Public Credit.› Other works by him are: ‹Economie politique, et politique Saint Simonienne› (1831); ‹La Religion Saint Simonienne› (1831); ‹Morale› (1832); ‹La livre nouveau› (1832).

Enfeoffment, ĕn-fĕf'mĕnt, the act of bestowing or conveying the fee-simple of any estate; or the instrument or deed by which the fee-simple of an estate is conveyed. See FEE-SIMPLE.

Enfield, William, English Nonconformist clergyman: b. Sudbury, England, 29 March 1741; d. Norwich, England, 3 Nov. 1797. In 1763 he became pastor to a congregation at Liverpool, and in 1770 became resident tutor and lecturer on belles-lettres at the academy at Warrington, where he remained for several years, and published several works, including his well-known ‹Speaker.› Here he also drew up ‹Institutes of Natural Philosophy,› theoretical and experimental. In 1791 he published his ‹Abridgment of Bruckers' History of Philosophy.›

Enfield, Conn., town, in Hartford County; on the Connecticut River, and the New York, N. H. & H. R.R.; 20 miles north of Hartford. Its chief manufactures are carpets, shoddy, powder, supplies for undertakers, and bicycles; and it has large brick works. A large amount of the now celebrated Connecticut tobacco is here prepared for use and shipped to different parts of the world. Shaker Station is a part of the town (see SHAKERS). Pop. (1910) 9,719.

Enfield, England, a market town in the county of Middlesex; on New River, nine miles northeast of London. Enfield is the seat of the well-known government manufactory of rifles and small-arms, and the «Enfield rifle» used in the British army is made here. Some noted people have lived in Enfield. See D'ISRAELI; LAMB; KEATS.

Enfield Rifle, a muzzle-loading rifle used in the British army prior to the introduction of the breech-loading system. It was also used in the United States during the Civil War by the Northern army, when Springfields could not be obtained, and by the Confederate army. In England large numbers of these rifles were converted into breech-loaders on the Snider principle, and were known as the Snider-Enfield or simply Snider.

Enfilade, ĕn-fĭ-lād' (from the Fr. *enfiler*), in the military art, is used in speaking of trenches or positions which may be raked by the enemy's shot along the whole length. In conducting the approaches at a siege care must be taken that the trenches be not enfiladed from any part of the place besieged. To avoid this they are generally cut in a zigzag.

Enfleurage, ŏṅ-flė-räzh, in perfume-making, the method of extracting, by contact and absorption, the scents of flowers used for perfumery. For this purpose wooden frames containing glass smeared with pure grease are filled with flowers, which are allowed to remain from one to six days. The grease gradually absorbs the scent, the flowers being renewed from time to time. The scent is afterward separated from the grease by soaking the latter in strong spirits of wine. Sometimes wire frames covered with cotton cloths, saturated with fine olive-oil, are used instead of glass. In this manner the most delicate odors are extracted from flowers, which would be lost in the process of distillation.

Eng and Chang. See SIAMESE TWINS.

Engadine, ĕn-gä-dēn, a beautiful valley in Switzerland, in the Grisons, on the banks of the Inn, bordering on the Tyrol. The language generally spoken is the Ladin, a branch of the Romanic tongue. Several towns and villages are situated in the valley, which is visited by numbers of strangers on account of its picturesque beauty and its mineral springs. Pop. 12,503.

Engano, ĕn-gä'ño, an island of the Malay Archipelago, 60 miles south of Sumatra. It is covered with forests and surrounded by coral reefs; area, including several small adjacent islands, 300 square miles. The natives are Malays. Pop. 6,410.

Engedi, ĕn-gē'dī or ĕn'gē-dī (Heb. «Fountain of the Goat›), on the western shore of the Dead Sea; about 30 miles southeast of Jerusalem. The modern Arabic name is Ain-Jidi. The ancient name was applied also to the eastern part of the Wilderness of Judah. The city, in the time of Abraham, was called Hazazon-tamar, the tamar meaning palm-tree. In 1 Samuel mention is made of David fleeing to the wilderness of Engedi to escape from Saul.

Engel, Carl, German-English writer on musical topics: b. near Hanover 6 July 1818; d. Kensington, London, 17 Nov. 1882. After a general musical education as pianist, organist and composer he removed to England and settled in London (1850). Here he studied the history of national music and musical instruments. Among his works are: ‘The Music of the Most Ancient Nations’ (1864); ‘Introduction to the Study of National Music’ (1866); ‘Musical Myths and Facts’ (1876); ‘Researches into the Early History of the Violin Family’ (1883).

Eng′el, Eduard, German literary critic: b. Stolp, Pomerania, 12 Nov. 1851. He made a German translation of ‘Italian Love-Songs’ (1875); and wrote ‘Lord Byron: An Autobiography from Journals and Letters’ (1876); ‘Psychology of French Literature’ (1884); ‘Did Bacon Write Shakespeare's Plays?’; ‘History of English Literature: With Appendix, American Literature’; ‘Wall to Wall’ (1890); and ‘Exiled and Other Stories.’

Engel, Johann Jakob, yō′hän yä′kōb, German prose writer: b. Parchim 11 Sept. 1741; d. there 28 June 1802. On the accession of King Frederick William III. of Prussia, whose tutor he had been, he was invited by his former pupil to Berlin, where he made himself exceedingly useful in the Academy of Sciences by his writings. Among his philosophical works may be mentioned his ‘Philosoph für die Welt,’ distinguished for acute observations on men and manners, enlivened by elegant illustrations. Of a similar character is his ‘Mirror for Princes’ (Fürstenspiegel). His ‘Ideen zu einer Mimik,’ full of taste, acuteness, and knowledge of human nature, may be regarded as a kind of manual for players. He also wrote several plays — ‘Der dankbare Sohn’; ‘Edelknaben,’ etc. His ‘Lorenz Stark,’ a novel, is a masterly picture of life and manners. A complete edition of his works appeared at Berlin (1801–6).

Engel, Karl Dietrich Leonard, German musician and writer: b. Grand Duchy of Oldenburg 21 Feb. 1824. He went to Russia as a violin virtuoso at the age of 18, becoming a member of the Imperial Orchestra at St. Petersburg at 22, and later its concert-master. He went to Dresden in 1869 and took up his residence there. Among his works are: ‘Deutsche Puppen Komödien’ (1874–93); ‘Das Volksschauspiel Doktor Johann Faust’ (2nd ed. 1882); ‘Zusammenstellung der Faustschriften vom 16. Jahrhundert bis Mitte’ (1884); ‘Die Don Juan Sage auf der Bühne’ (1887).

Engelbrechtzen, ĕng′ĕl-breнt-zĕn, **Cornelis,** Dutch painter: b. Leyden 1468; d. there 1533. He was the son of the wood-engraver Engelbert, and the teacher of Lucas, being the earliest known painter in Leyden. Many of his works were destroyed during the Reformation, but among his authentic paintings are: Altarpiece with ‘Crucifixion,’ and altarpiece with ‘Pieta,’ Town Hall, Leyden. Doubtfully attributed to him are: ‘St. Leonard,’ Antwerp Museum; ‘Crucifixion,’ old Pinakothek, Munich; ‘Deposition,’ Moritz Chapel, Nuremberg; ‘Madonna and Child,’ National Gallery, London; ‘Crucifixion,’ Venice Academy.

Englehard, Friedrich Wilhelm, frēd′riн vil′hĕlm ĕng′ĕl-härt, German sculptor and painter: b. Grunhagen, Prussia, 1813; d. 1902. He studied at Hanover, at Copenhagen with Thorwaldsen, and at Munich with Schwanthaler. He executed many groups, single figures and genre pieces. Among his creations are: ‘Love on a Swan’; ‘Dancing Springtime’; ‘Slinger with Dog’; ‘Bacchus Conquering a Panther’; ‘Cupid and Psyche’; the frieze of the ‘Edda,’ his chief work; ‘A Child Fishing’; ‘A Child Threading a Needle’; statue of ‘St. Michael’; portrait medallion of Bismarck for the monument of Canossa, near Harzberg; ‘Christ Blessing Little Children’; and the legendary characters of Germany, ‘Odin,’ ‘Thor,’ and the Valkyries.

Engelhardt, Johann Georg Veit, German theologian: b. Neustadt-an-der-Aisch, Bavaria, 1791; d. Erlangen 13 Sept. 1855. In 1822 he became professor of theology at Erlangen; during the years 1845, 1847, and 1848 was the representative of his university in the diet at Munich. His most celebrated works are a translation of the writings ascribed to Dionysius the Areopagite; ‘Handbuch der Kirchengeschichte’ (1834); ‘Richard von St. Victor und Johannes Ruysbroek’ (1838); ‘Auslegung des speculativen Theils des Evangeliums Johannis durch einen deutschen mystischen Theologen’ (1839); ‘Dogmengeschichte’ (1839).

Eng′elmann, George, American botanist: b. Frankfort-on-the-Main 2 Feb. 1809; d. St. Louis, Mo., 4 Feb. 1884. He studied at Heidelberg, Berlin, and Würzburg, and emigrated to the United States in 1832. In 1835 he began the practice of medicine at St. Louis, Mo. He early devoted his attention to botany, becoming the chief authority on the North American vine and cactus. He was the first president of the St. Louis Academy of Science, and his exhaustive botanical collection is in the Shaw Botanical Garden, St. Louis.

Engelmann, Johannes, yō-hän′nes ĕng′ĕl-män, Russian jurist: b. Mitau, Courland, 7 July 1832. Educated at the University of St. Petersburg, he became professor of Russian law at Dorpat 1860, retaining the chair for 39 years, and delivering his lectures in Russian instead of German after 1887. Among his works are ‘Die Verjahrung nach russischem Privatrecht’ (1867; in Russian, 1868); ‘Die Zwangsvollstreckung auswärtiger richterlicher Urteile in Russland’ (1884).

Engels, ĕng′ĕls, **Friedrich,** English Socialist: b. Bannen, Prussia, 28 Nov. 1820; d. London 5 Aug. 1895. He lived mainly at London after 1869. He was an intimate friend of Karl Marx (q.v.), and his most efficient helper in the work of organizing the Socialist movement. In 1870 Engels was corresponding secretary of the International Workingmen's Society for Belgium, Italy and Spain. With Marx he wrote the ‘Communist Manifesto’ (1847); he also wrote ‘The Working Class in England in 1844’ (new edition 1892); ‘The Origin of the Family’; ‘The Development of Socialism from Utopia to Science’ (1894, a part of a large work left unfinished); and edited Marx's ‘Capital.’

Engerth, ĕng′ĕrt, **Eduard von,** Austrian painter: b. Pless, Silesia, 13 May 1818. He was a pupil of the Vienna Academy, taking the gold medal there in 1845. He became director of the Prague Academy 1854 and in 1855 professor at the Vienna Academy. He was appointed director of the Belvedere Gallery 1871 and director of the Academy 1874. He was made commander of the order of Francis Joseph 1867. Among his works are: 'Haman and Esther'; 'Ladislaus and Akus' (1844); 'Coronation of Rudolph I.'; 'Joseph Explaining the Dream' (1845); 'Seizure of King Manfred's Family' (1853), a masterpiece in the Vienna Museum; 'Victory of Prince Eugene at Zenta' (1865); 'Marriage of Figaro'; 'Fable of Orpheus' (1868); 'Coronation of Francis Joseph as King of Hungary' (1870); 'Death of Eurydice' (1877).

Enghien, Louis Antoine Henri de Bourbon, loo-ē ăn-twän ŏṇ-rē dė boor-bôn ăn-găn, DUKE OF, French prince: b. Chantilly 2 Aug. 1772; d. Vincennes, France, 21 March 1804. He was the son of Louis Henry Joseph Condé, Duke of Bourbon. From 1796 to 1799 he commanded with distinguished merit the vanguard of Condé's army, which was disbanded at the Peace of Lunéville (1801). He then married and took up his residence at Ettenheim, in Baden. He was generally looked upon as the leader of the *émigrés,* and was suspected by the Bonapartists of complicity in the attempt of Cadoudal to assassinate the First Consul. The spies of Napoleon reported that Enghien was often absent for 10 or 12 days together from Ettenheim, and it was believed that on some of these occasions he had secretly visited Paris. Napoleon therefore invaded the duchy of Baden and the Duke of Enghien was seized 15 March 1804, conducted to Starsburg, and thence to the fortress of Vincennes, where he arrived on the evening of the 20th. That same night a court-martial was assembled, and the prisoner was, after a mock trial, in which no witnesses were examined, found guilty on various charges of treason. He requested an interview with Bonaparte, which was refused, and he was immediately led out to execution. He was shot between 4 and 5 o'clock in the morning in the ditch outside the walls, and his body was thrown, dressed as it was, into a grave dug, it is said, the day before. Napoleon and the other chief actors in the tragedy took every pains to justify their conduct, or to throw the chief blame upon others' shoulders, and it is believed by some that the First Consul found himself in the position of a leader whose subordinates are only too ready to rush extreme measures on the least hint from their master.

Enghien, or Enguien, Belgium, (1) Town in Hainault, about 19 miles southwest of Brussels. One of the chief occupations is lace making. (2) A watering place a short distance north of Paris.

Engine. A motor or prime mover which is capable of absorbing the inherent forces of material substances such as steam, gas, and water through the medium of heat and pressure, and then converting those forces into mechanical energy in the form of motion, which may be utilized for doing mechanical work, thus distinguishing it from a «machine,» which can receive motion only from a motor or engine external to itself.

The various forms of engines may be classified into two general groups — heat engines and hydraulic engines, according to the manner in which they convert the natural forces into mechanical energy, power, or work.

All heat engines act through the medium of a working substance which absorbs heat, converts a portion of that heat into mechanical energy, which is represented by the work performed by the engine, and rejects the remaining portion of the heat, still in the form of heat. The working substance may be a gas, a liquid, or a solid, and incidentally affords a basis upon which the various practically successful forms of heat engines may be conveniently grouped into three general classes — steam engines, gas and oil engines, and steam turbines.

Steam Engines.— In all forms of actual steam engines, the working substance is saturated steam, a fluid consisting of a mixture of water and steam in varying proportions, the expansive energy of which is utilized to drive or impart motion to a piston working within a cylinder.

They may be classified as follows: (1) according to the manner in which the steam is utilized; (2) according to the mechanical arrangement of their parts; and (3) according to the purposes for which they are used.

The first class includes the high-speed and low-speed engines; the single-acting and double-acting engines; the direct-acting and indirect-acting engines; the expansive working and non-expansive working engines; the condensing and noncondensing engines; and the simple engines, compound engines, and multiple-expansion engines, which may be briefly described as follows:

High-Speed Engine.— One in which the piston speed exceeds 900 feet per minute. It possesses the advantages of small dimensions and small weight for a given power, and on account of the frequency of its strokes, is capable of meeting variations in loading more quickly than a low-speed engine. Its disadvantages consist in the greater waste of steam, the greater wear, and the increased danger of the heating of the moving parts. Also, the higher cost of construction and operation.

Low-Speed Engine.— One in which the piston speed is less than 600 feet per minute.

Single-Acting Engine.— One in which the pressure of the steam is exerted only on one side or the under side of the piston, which is pressed down again by the pressure of the atmosphere on the other side against the vacuum produced by the condensation of the spent steam. They were formerly used chiefly for pumping purposes, and in connection with steam hammers, but are now practically out of date.

Double-Acting Engine.— One in which the steam acts alternately on both sides of the piston, either against the pressure of the air, or against the vacuum of the condenser. Originally, all engines were made single-acting, but all modern engines are made double-acting.

Direct-Acting Engine.— One in which the action of the piston is transmitted directly to the crank-shaft. Nearly all engines are direct-acting engines.

Indirect-Acting Engine.— One in which the motion of the piston is communicated to the crank-shaft by means of intermediate levers. In the beam-engine, the connection between the piston and the connecting rods consists of a beam, the oscillating point of which is placed midway between the two rods. They are chiefly employed for pumping purposes, and for driving paddle-wheel steamers. Other than in this limited field, they are becoming practically obsolete.

Expansive Working Engine.— An engine is worked expansively when the steam, instead of being admitted at full pressure into the cylinder until the termination of the stroke, is cut off at some fractional part of the stroke and thus caused to do work simply by its own expansion. The steam may be expanded in one or more cylinders. The amount of steam consumed is low as compared to the amount of work done. It is universally used where circumstances will permit, on account of its greater economy as compared to the engines of the nonexpansive working type.

Nonexbansive Working Engine — An engine in which the steam is allowed to enter the cylinder at boiler pressure, and is maintained at that pressure behind the piston during the whole of the stroke. The amount of steam consumed is disproportionately high as compared to the work done. It is never used except in cases where circumstances will not permit of the use of an expansive working engine.

Condensing Engine.— One in which the spent steam in the cylinder is exhausted into a vacuum and condensed into water, thus obliterating the back pressure of the atmosphere, and consequently effecting a gain of pressure equivalent to 14.7 pounds per square inch, in the effective working pressure of the steam.

Noncondensing Engine — One in which the spent steam in the cylinder is exhausted into the air at atmospheric pressure, thus entailing the work of forcing the piston against a back pressure of 14.7 pounds per square inch, at the expense of the effective working pressure of the steam.

Simple Engine.— One in which the steam after having forced the piston through its stroke is exhausted into the air, or into a vacuum or condenser.

Compound Engine.— An engine with two or more cylinders in which the steam after having expanded and performed its work in one cylinder passes into the next cylinder, of larger size, and continues to expand and perform work. The different types of compound engines are distinguished by the number of cylinders employed for the expansive working of the steam, and are designated as the two-cylinder compound engine, the three-cylinder or triple-expansion engine, and the four-cylinder or quadruple-expansion engine. The cylinders are usually arranged side by side or parallel with each other. Sometimes, as in the case of the « tandem-compound,» they are placed « in line » one behind the other, and also vertically one above the other as in the case of the « steeple-compound.» In a « cross-compound.» the cylinders are placed side by side and parallel to each other, but sufficiently far apart to allow space for a fly-wheel between them. Up to the present time, the quadruple-expansion engine appears to be the limit beyond which the number of expansions have not been carried with success. The great practical advantage of the multiple expansion engines lies in their high steam economy.

The second class of steam engines includes the various types of reciprocating engines which are more definitely designated as horizontal engines, vertical engines, and inclined engines, according to the position of the axis of the piston, and various forms of direct-acting and indirect-acting engines, such as beam engines, oscillating engines, trunk engines, back-acting engines, and various forms of rotary engines.

The third-class includes the various forms of marine engines, stationary or land engines, locomotive engines, and a great variety of portable engines. The engines included in these two classes may be briefly described as follows:

Reciprocating Engine.— One in which the piston moves backward and forward alternately, in a right line. Almost all heat engines are of this type.

Horizontal Engine.— One in which the axis of the cylinder and piston rod is horizontal.

Vertical Engine.— One in which the axis of the cylinder and piston rod is vertical. Vertical engines are made in a great variety of forms, and are usually arranged with the cylinders uppermost. Very few of them are constructed with the cylinders lowermost, and those are only of the smallest sizes. The principal advantages of the vertical engines consist in the small space required for their foundations, and the uniformity of wear on the cylinders, pistons, and rods. The type includes many forms of steam hammers, launch engines, screw engines, and inverted cylinder engines.

Inverted Cylinder Engine.— A vertical engine in which the cylinder is inverted or placed above the piston rod, connecting rod, and crank-shaft. It is typical of the marine engines employed to drive screw propellers.

Inclined Engine or Inclined Cylinder Engine. — A form of marine engine in which the cylinders are inclined toward each other at an angle of about 120 degrees, and make a triangle with the base. They are connected by cranks to a common crank-shaft.

Beam Engine.— An indirect-acting engine in which the piston rod is connected to the connecting rods by means of a lever in the form of a beam. It is more fully described under the term Indirect-Acting Engine.

Oscillating Engine.— A marine engine of the direct-acting type in which the cylinders are suspended upon hollow trunnions and oscillate thereon, thus allowing the motion of the piston rods to accommodate itself to that of the crank at all parts of the revolution. It occupies but little space, and is peculiarly adapted for paddle-wheel steamers. For screw propulsion, it has been entirely supplanted by the various forms of multiple-expansion engines of the inverted cylinder type.

Trunk Engine.— An interesting though practically obsolete form of marine engine formerly used on war vessels. The aim of its design is compactness of arrangement, so as to place all of its working parts below the waterline, thus protecting them from the enemy's shot. Its distinguishing feature is a hollow, trunk-shaped piston rod which passes through both ends of the cylinder and is encircled in the middle by the piston head. The connecting rod is attached to the interior of the piston rod, thus saving the length of the piston rod in all of the vertical dimensions of the engine. Its chief defect consists in its low steam economy, due to the great loss of heat by radiation from the large conducting surfaces of the hollow piston rod which are exposed to the air.

Bogie Engine.— A locomotive provided with a bogie or swivelling framework which carries the axle of the main driving wheels, and enables the main framing to accommodate itself to curves of short radii. In the single bogie, the main driving wheels are the bogies; in the double bogie, both the main driving wheels and the back driving or trailing wheels are bogies. A bogie truck is a short four-wheeled truck pivoted at its centre to the main frame of the engine, and enables the engine to run around sharp curves.

Corliss Engine.— A very economical type of engine in which the valves are controlled automatically from the governor, and the steam supply proportioned to the requirements of the engine at each moment during its working stroke. The valve forms a segment of a circle and revolves through an arc of a circle, and alternately covers and uncovers the steam port. It is operated by a rod from a wrist plate, but is disconnected at every stroke of the engine, and the supply valve closed instantaneously by means of a dash-piston and spring.

Cornish Engine.—A standard type of pumping engine, originally of the single-acting type. At the present time it appears in two forms — the beam engines and the direct-acting engines. The valves of a Cornish engine are operated by a special device called a cataract consisting of a weighted piston which works in a cylinder provided with a large inlet valve and a small discharge valve. The working stroke of the pump lifts the weighted piston and draws the water into the cylinder through the former, and the return stroke discharges it through the latter, and at the same time actuates the valves of the steam cylinder of the pump so as to cause another working stroke.

Marine Engine.— Any form of engine used for propelling a vessel. They are usually of the compound or multiple-expansion type.

Stationary Engine.— An engine on fixed foundations, as distinguished from the locomotive, portable, and marine engines.

Locomotive Engine.— A high pressure steam engine and multitibular complete, mounted on a carriage, and provided with suitable wheels to enable it to draw loaded cars upon a permanent way or railway track.

Portable Engine.— An engine of the locomotive type, mounted on a carriage which permits of its being moved from place to place for use in connection with work of a temporary character. Portable engines are extensively used for agricultural purposes, and for general traction purposes on ordinary highways.

Gas and Oil Engines.— These classes of heat engines are commonly designated as internal combustion engines for the purpose of distinguishing them from the various more or less impracticable forms of hot air engines in which the working substance consists of air alone, which is heated from an external furnace, the heat being conducted through the walls of the containing vessel.

In the gas engines, the working substance or charge is a mixture of coal gas and air, explosive in character, which is introduced into the working cylinder where it is compressed by the action of the piston, and then ignited and exploded by a special device. The energy developed by the explosion is utilized to actuate the piston or do mechanical work.

This method of heating the working substance is called the gas engine method. It is one feature possessed in common by all gas engines irrespective of variations in form, or of working cycles, and serves to distinguish them from all other forms of heat engines.

The various types of gas engines may be conveniently divided into three general classes, according to their mode of operation as follows: (1) Those in which a specified amount or constant volume of gas is drawn into the cylinder at atmospheric pressure or without compression, and then ignited, as in the case of the Lenoir, Hugon, and the Otto-Langen engines, which were quite successful for powers under one-horse power, but are practically obsolete; (2) those in which the working substance is first compressed in an auxiliary cylinder and then admitted to the working cylinder and ignited, as in the case of the Brayton engine, which although the most successful engine of this class is also practically obsolete; and (3) those in which a specified amount or constant volume of gas is admitted to the working cylinder where it is compressed by the piston and then ignited, as in the case of the Otto engine, and in, by far, the greater number of other gas engines in successful use at the present time.

Gas engines are also designated as two-cycle, four-cycle, and six-cycle engines, according to the number of distinct operations in their working cycles. The six-cycle engines were of the scavenging type, but were not successful, and are obsolete. The four-cycle engines represent the application of the Beau de Rochas or Otto cycle, and constitute the most successful type developed up to the present time. The two-cycle engines are as yet in a comparatively experimental state, but possess great possibilities of successful development, and may eventually supplant all the other forms.

Up to within the last few years, the gas engines were rarely made in sizes capable of developing an amount of power equivalent to 50, 75, or 100 horse-power, and rivalled steam engines of equal capacity only in special and limited fields of application; but now, since the introduction of the various gas producer systems, gas engines developing 4,000 horse-power are in successful use, and others capable of developing as high as 6,000 horse-power are in the process of construction.

The oil engine differs from the gas engine principally in the character of the charge, which consists of a mixture of vaporized petroleum, gasoline, or paraffin oil and air. They may be conveniently classified, (1) according to the method employed to vaporize the oil; or (2) according to the method employed to ignite the charge.

The first class includes those in which the oil is subjected to a spraying operation before being vaporized; those in which the oil is injected into and vaporized within the cylinder; and those in which the oil is vaporized by a special apparatus outside the cylinder and then admitted into the cylinder in the form of a vapor.

The second class includes those in which the charge is ignited by means of an electric spark; those in which the charge is ignited by an incandescent tube; and those in which the charge is ignited by the heat of the internal surfaces of the combustion chamber.

Steam Turbines comprise a class of heat engines in which the kinetic energy of expanding steam is utilized to drive a wheel and thus convert the natural heat energy of steam directly into mechanical energy in the form of rotary motion. The principal forms are the Parsons, De Laval, Seger, and Dow turbines, and their chief field of application and development appears to be in the marine service. Noteworthy examples of their latest applications are those of the Cunard Line Passenger Steamship «Carmania,» and the battleship «Dreadnaught,» of the British Royal Navy, the largest warship in the world built up to date.

Hydraulic Engines.—Mechanical power is obtained from flowing water by its weight, pressure, or impact, utilized in various forms of water wheels, turbines, hydraulic rams, and water pressure engines. In the water pressure engine the pressure of the water only is utilized to drive a piston in a cylinder. In some forms the action of the piston is reciprocating, and in others rotary. In all of them the actual amount of pressure expended is only that which is needed to impart motion to the fluid to follow the piston and escape from the cylinder, and, therefore, the greatest efficiency is obtained by making the piston as small as practicable and using a large pressure. The majority of them are of the reciprocating, low-speed type, and are particularly useful as secondary motors for operating the opening machinery of various forms of swing, draw, and lifting or rolling bridges, and in connection with cranes and various forms of hydraulic lifts.

For further detailed information relative to the construction, operation, and application of the various forms of engines, consult the articles under the titles: GAS ENGINES; LOCOMOTIVE; LOCOMOTIVE, DESIGN AND CONSTRUCTION OF THE MODERN; LOCOMOTIVE ENGINE; PUMPS AND PUMPING MACHINERY; ROTARY STEAM ENGINE; TRACTION ENGINES; TURBINES; WATER MOTOR; AND WATER WHEELS, in this Encyclopedia.

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Engine, Testing of. Engines are tested in order to determine the economy with which they produce a given amount of power. The economy of steam engines, as usually determined, relates to the weight of steam consumed, or to the quantity of coal used in making the steam, or to the number of heat units supplied; while in the case of an internal combustion engine, it relates to the amount of gas, gasoline, oil, alcohol, or other fuel burned. Also, if the latter operate on producer gas, the determination of economy involves the amount of coal burned in the gas producer.

Factory tests are generally limited to the performance of individual engines, to determine the set of the governor relative to the proper speed, and to ascertain if the valves are set and operate properly. In the case of gas engines, the factory test is extended to cover the correct timing of the igniter, and to determine the correct compression.

In its broadest sense, however, testing is a form of scientific investigation conducted for the purpose of securing practical results which are very important not only to the manufacturer, but also to the owner of the engine who has to pay the expense of its operation, and to those who require information showing the capabilities of the machines for the purpose of advertising and trade.

As an engine test involves the determination of two elementary quantities,—(1) the amount of fuel consumed, and (2) the amount of power developed,—it is necessary that these two factors should be represented by units of measurement which are susceptible of universal application.

Standard Unit of Fuel.—The most satisfactory unit for expressions of economy based on the amount of fuel consumed, is the British Thermal Unit (B.T.U.), which is the quantity of heat required to raise one pound of water one degree Fahrenheit at or about 39.1° Fahr. According to Joule, it is equivalent to 778 foot-pounds of mechanical energy.

A convenient and useful subsidiary standard is that based on a «standard coal» unit. the term «standard coal» defining a coal which imparts to steam 10,000 B.T.U.'s for each pound of dry coal consumed. It is a coal which has a calorific value of 12,500 B.T.U.'s, equivalent to an efficiency of 80 per cent. when used in a «standard boiler.»

Standard Unit of Power.—The unit of mechanical power which most satisfactorily expresses the power developed by an engine, is the «horsepower,» which represents an energy of 33,000 foot-pounds per minute, equivalent to 2,545 B.T.U.'s per hour.

Standard of Engine Economy.—Employing the given standard units of fuel and power, the expressions of engine economy which are best adapted to meet all conditions of service, and for all classes of heat engine, are those represented by the «indicated» horsepower based on the number of B.T.U.'s consumed per hour.

Such an expression is commonly called a horsepower-hour, and represents a heat energy of 1,980,000 foot-pounds converted into mechanical power or work by the consumption of 2,545 B.T.U.'s per hour.

Rules for Conducting a Test.—All tests should be conducted systematically under a set of standard rules, clearly defining the character of the data to be obtained and the methods which should be employed for their determination. A set of such rules may be briefly defined as follows:

1. *Object of the Test.*—At the beginning, the specific object of the test should be ascertained. It may relate to the determination of highest economy obtainable; the economy under ordinary working conditions and the existing defects; the performance under special conditions; the effect of changes in existing conditions; or the fulfillment of a contract guarantee; and the preparations for the test should be made accordingly. These preparations will necessarily depend largely upon the good sense, judgment, and ingenuity of the engineer making the test.

2. *Condition of the Engine.*—The engine should be carefully examined and its general condition noted, especially any points of design, construction, or operation which bear upon the object of the test. Special examination should be made of all valves, by inspecting their seats and bearing surfaces, and great care taken to ascertain, in the case of a gas engine, that the piston rings work freely in their grooves and are perfectly gas-tight.

3. *Dimensions.*—The cylinder dimensions should be taken whether they are already known or not, the measurements being made when they are hot and in working order. When practicable, the clearance volume or compression space of the cylinder should be measured by filling it with water previously measured, the proper correction being made for temperature.

4. *Fuel.*—When the test involves the complete plant—in the case of a steam engine including the boilers, and in the case of a gas engine including the gas producer plant,—the class, name of mine, size, moisture, should be stated in the report,—and the quality of the coal used should be of some recognized standard. This is desirable for purposes of comparison. In the case of an internal combustion engine, if the test is made to determine the maximum efficiency, the gas, oil, or other fuel used, should be the best obtainable, or one that possesses the highest calorific value.

5. *Measurement of Fuel.*—The methods of determining the amount of fuel consumed depend upon the character of the fuel used. If it be coal furnished to the furnace of a boiler, or to a gas producer, the amount consumed during a period not less than 24 hours should be carefully measured by weight. If it be oil, gasoline, distillate, alcohol, etc., it can be drawn from a tank, which can be refilled to the original level at the end of the test, and the amount required for this purpose weighed; or in the case of a small engine, it can be drawn from a properly calibrated vertical pipe. When gas is used, it should be measured by a suitable gas meter, and gas bags should be placed between the meter and the engine to keep the pressure as constant as possible. The pressure and temperature of the gas, and the barometric pressure and temperature of the air, should be measured, and in determining the quantity of the gas supplied, as given by the reading of the meter, the temperature and pressure of the gas should be taken into account.

6. *Measurement of Heat Units Consumed.*—The number of heat units consumed by the engine can be found by multiplying the number of pounds of coal or oil, or the cubic feet of gas supplied, by the total heat of combustion of the fuel as determined by a calorimeter, or from the results of a chemical analysis. In determining the total heat of combustion, usually, no deduction is made for the latent heat of the vapor of water in the products of combustion, therefore, for purposes of comparison care should be taken to state whether the higher or the lower value has been used in the determination.

The Mahler calorimeter is the most suitable for determining the heat of combustion of solid fuels and oils, and the Junker calorimeter for gases.

7. *Instruments and Their Calibration.*—All instruments and apparatus used in the tests should be calibrated, and their accuracy verified by comparison with recognized standards. All such as are liable to undergo changes, or become broken during the progress of a test, especially gauges, indicator springs, and thermometers, should be calibrated both before and after the test.

Gauges.—For measuring pressures above that of the atmosphere, the most convenient and reliable standard is the dead-weight testing apparatus consisting of a cylinder having a close-fitting vertical piston working in oil or glycerine, by the medium of which the pressure is transmitted to the gauge. The piston is surmounted by a circular stand on which weights may be placed so as to secure any desired pressure. The total weight, in pounds, on the piston, divided by the area of the piston, in square inches, gives the pressure in pounds per square inch.

The mercury column is another reliable standard of comparison for pressures, but when it is used care should be taken to see that it is properly graduated with reference to the ever varying zero point; that the mercury is pure, and that the proper correction is made for any difference of temperature that may exist at the time of using, and the temperature at which the instrument was graduated.

For pressures below that of the atmosphere, the use of an air pump or some other means of producing a vacuum is required. The apparatus must be referred to a mercury gauge, which may consist of an U-shaped tube about 30 inches in length, with both arms properly filled with mercury.

Thermometers.—Standard thermometers are those which read 212° Fahr. in steam escaping from boiling water at the normal barometric pressure of the atmosphere (29.92 inches) when the whole stem up to the 212° point is surrounded by the steam; and which read 32° Fahr. in melting ice, when the stem is completely immersed to the 32° point; and which are calibrated for points between and beyond these two points of reference.

For temperatures between 212° and 400° Fahr., the thermometers should be compared with the temperatures given in Regnault's Steam Tables, by placing it in a mercury well surrounded by saturated steam under sufficient pressure to give the desired temperature.

For higher temperatures, such as those occurring in gas-engine practice, which often exceed 2,000° Fahr., some form of pyrometer or calorimeter should be used. That of Le Chatelier, which makes use of the thermocouple, has been successfully used for accurately measuring temperatures over 2,500° Fahr.

Indicator Springs.—For gas engine indicating, the indicator springs used should be much stiffer and stronger than those used for steam-engine work, so as to enable them to withstand the higher and more suddenly developed pressure. When indicator springs are calibrated, the temperature of the indicator should be as nearly as possible the same as that which exists during the test. An indicator may be conveniently heated by subjecting it to steam pressure immediately before calibration, and the actual work of calibration then performed by the use of compressed air or compressed carbonic acid gas. The calibration may be made under a constant pressure, or more satisfactorily by covering the whole range of pressures through which the indicator acts, by gradually increasing the pressure from the lowest to the highest point, and then by gradually reducing it from the highest to the lowest point, and a mean of the results taken for at least five points—two for the pressures corresponding to the maximum and minimum pressures, and three for equally distant intermediate points. These values should be compared with a dead-weight-testing apparatus, a mercury column, or a steam gauge, compared with either of the two first-named standards, and the correct scale of the spring used for calculating the mean effective pressure from the indicator diagrams taken during the test should be the average based on this calibration.

Gas Meters.—A meter used for measuring the gas supplied to a gas engine, should be calibrated by comparing its readings with the displacement of a gasometer of known volume; with a standard gas meter of known error; or by passing air through the meter from a tank containing air under pressure. In the latter case, the pressure and temperature of the air in the tank, both at the tank and the meter, should be observed at uniform intervals of time during the work of calibration; and the amount of air passing through the meter calculated from the volume of the tank and the observed temperatures and pressures.

The volume of the gas thus ascertained should be reduced to the equivalent volume at a given temperature and atmospheric pressure, corrected for the effect of moisture in the gas, which is usually at or near the point of saturation. For gas-engine work, a convenient standard is the equivalent volume of the gas when saturated with moisture at normal atmospheric pressure at a temperature of 60° Fahr. A volume of moist gas at any other temperature may be reduced to this standard by being multiplied by the factor

$$\frac{459.4+60}{459.4+t} \times \frac{b-(29.92-s)}{29.4},$$

in which b represents the reading of the barometer in inches at 32° Fahr.; t, the temperature of the gas at the meter in degrees Fahr.; and s, the vacuum in inches of mercury corresponding to the temperature of t given in the steam tables.

8. *Duration of a Test.*—The length of time devoted to a test will depend largely upon its character and the purpose for which it is made. For determining the working economy, the time allowed should be equal to the number of hours per day during which the engine is really operated. In the case of a gas engine using producer gas, the time should be sufficient to determine the amount of coal used in the gas producer. It should never be less than 24 hours, and usually, it should extend over several days.

9. *Commencement of a Test.*—If the test is to determine the performance of an engine under working conditions, it should begin at the time the engine is started, and the observations continued until it shuts down for the day. If the test is for determining the maximum economy of the engine; at first, it should be run a sufficient length of time to make all conditions normal and constant, then the observations may be commenced and continued for the allotted time.

10. *Measurement of Water.*—In the case of a steam engine this relates to the feed water or steam consumption. The usual method is to measure all the feed water supplied to the boilers, and deduct therefrom all the water discharged by separators and drips, and the water and steam lost by leakage from the boiler and its main and branch pipe connections with the engine. Where the engine exhausts into a surface condenser, the steam consumption can be measured by measuring the quantity of water discharged by the air pump, and adding thereto the steam used by jackets, reheaters, and auxiliaries as determined independently. In measuring the water, it should be carried through a tank resting on the platform of a suitably arranged weighing scales, and the water subsequently emptied into a reservoir beneath, from which the pump is supplied.

For measuring small quantities of water, about 6,000 pounds per hour, the most convenient apparatus consists of a small hogshead connected to the suction pipe of the pump or injector, and an ordinary oil barrel placed on a platform scale. The barrel is filled by means of a cold-water pipe leading from the source of supply. For pressure not less than 25 pounds per square inch, this pipe should have an internal diameter of 1½ inches. The outlet valve of the barrel is attached to the side, near the bottom, and should be at least 2½ inches in diameter, so as to permit of quick emptying.

Where larger quantities of water have to be measured, the barrel can be replaced by a hogshead and two hogsheads can be joined together for the lower reservoir. With this arrangement, when the weighing hogshead is supplied through a 2½-inch valve under 25 pounds of pressure, and emptied through a five-inch valve, the capacity attained is 15,000 pounds of water per hour.

For the measurement of very large quantities, or in some cases, very small quantities, the orifice method gives the most satisfactory results, and when applied, the average head of water on the orifice must be ascertained, and the discharge of the orifice should be calibrated under the conditions of use.

In the case of an internal combustion engine, the measurements of water relate to that supplied to the water-jacket provided for cooling the temperature of the cylinder. The measurements may be made by the methods already described, but care should be taken, in cases where the temperature exceeds 212° Fahr., to first cool the water by discharging it into a tank of cold water previously weighed, or by passing it through a coil of pipe immersed in running cold water, so as to prevent the loss of evaporation which takes place when hot water is discharged into the open air.

11. *Determination of Speed.*—The speed of the engine or the number of revolutions of the crank shaft per minute can be determined by counting the number of revolutions in one minute with the eye fixed on the second hand of a timepiece, or by the use of some form of mechanical counter such as a tachometer, or continuous recording engine register. The use of such instruments is imperative when the speed exceeds 250 revolutions per minute.

In the case of internal combustion engines governed by the hit-or-miss method, the number of explosions per minute should be ascertained, when the engine is running under nearly maximum load, by counting the number of times the action of the governor causes a miss in the explosions.

The determination of variation of speed during a single revolution on the effect of fluctuations due to sudden changes of load, should be made especially in the case of engines employed to drive electric generators used for lighting purposes.

12. *Indicator Diagrams.*—From the indicator diagrams taken during the test for the computation of the mean effective pressure, etc., sample diagrams nearest to the mean should be appended to the report.

The mean effective pressure (M.E.P.) is obtained as follows: Measure the diagram with a planimeter and divide the area, in square inches, thus obtained by the length of the diagram in inches to obtain the mean height or mean ordinate of the diagram. Multiply the mean ordinate by the scale of the indicator spring and the product will be the mean effective pressure desired. In the absence of a planimeter, the diagram can be divided by ten ordinates and their mean length taken for that of the mean ordinate. If the indicator is specially designed for indicating internal combustion engines, the mean ordinate should be multiplied by twice the scale of the spring, unless the scale has been expressly marked for the reduced piston.

In the case of internal combustion engines, when indicator diagrams are not obtainable and the compression pressure is known, the mean effective pressure may be determined approximately as follows: For example, in gas engines the compression pressure ranges from 70 to 90 pounds per square inch, and the maximum pressure developed by the explosions is about 3.5 times the compression pressure. Therefore, if p represents the compression pressure, then for compressions of 100 pounds per square inch or less, $M.E.P. = 2p - 0.01p^2$; thus, if $p = 70$ pounds per square inch, $M.E.P. = 140 - 49 = 91$ pounds per square inch.

In the case of a steam engine, the steam accounted for by the indicator diagram may be calculated by means of the formula

$$M - \frac{13750}{M.E.P.}\left((C+E)\times Wc-(H+E)\times Wh\right),$$

which will give the weight in pounds per indicated horsepower per hour. M.E.P. represents the mean effective pressure, which in the case of a multiple-expansion engine is the combined mean effective pressure referred to the cylinder in question. For example: In the case of a compound engine, the combined mean effective pressure for the high pressure cylinder consists of two items: (1) the mean effective pressure of the high pressure cylinder, and (2) the mean effective pressure of the low pressure cylinder multiplied by the ratio of the piston displacement of the low pressure cylinder to that of the high pressure cylinder. The sum of these two items is the combined mean effective pressure for the high pressure cylinder.

Similarly the combined mean effective pressure for the low pressure cylinder consists of (1) the mean effective pressure of the low pressure cylinder, and (2) the mean effective pressure of the high pressure cylinder divided by the ratio already stated. The sum of the two items is the combined mean effective pressure of the low pressure cylinder.

In the given formula, C represents the proportion of the piston stroke completed at points on the expansion line of the diagram near the actual cut-off or release; H the proportion of compression; and E the proportion of clearance; all of which are determinable from the indicator diagram. Wc represents the weight of one cubic foot of steam at the cut-off or release pressure; and Wh the weight of one cubic foot of steam at the compression pressure.

13. *Standards of Economy and Efficiency.*—The standard expression for engine economy, as already stated, is the hourly consumption of heat units divided by the indicated horsepower or the brake horsepower. The standard expression for efficiency is the thermal efficiency ratio, or the proportion which the heat equivalent of the power developed bears to the total amount of heat actually consumed, as determined by test. One horsepower-hour represents the consumption of 2,545, B.T.U.'s per hour, therefore,

$$\frac{2{,}545}{\text{B.T.U.'s per horsepower per hour}},$$

expresses the thermal efficiency ratio.

In comparing the standard for internal combustion engines with that for steam engines, it must be noted that the former usually covers the losses due to combustion, but the latter does not, and therefore, in order to make a direct comparison between the two classes of engines as complete horsepower plants, the losses in generating the working agent must be considered in both cases not only on the basis of the fuel used, but on the basis of equivalent fuel used in each case. In comparing a gas engine plant using producer gas, with a steam plant, the producer should be included in the former, and then the fuel consumption, represented by the weight of coal in both cases, may be directly compared.

14. *Heat Analysis.*—For scientific purposes, a heat analysis of the indicator diagram, in the case of a steam engine, and a heat balance in the case of an internal combustion engine, should be made, showing the manner in which the total heat of combustion is expended in working the engine.

In the case of a steam engine, the analysis shows the interchange of heat from steam to cylinder walls, etc. For example: the amount of heat supplied to the engine in a given time is represented by the number of pounds of steam supplied multiplied by the total heat of one pound of steam. A portion of this heat is used in the jacket, if one be employed, and the remainder passes through the cylinder. The heat entering the jacket is lost partly by radiation from the outside surface, and the remainder enters the walls of the cylinder and is absorbed by the steam within it. The cycle of operations within the cylinder consists of the following phases: (1) A portion of the entering heat is transferred into a small portion of the thickness of the cylinder walls, and heats them to the temperature of the entering steam. This transference of heat is more active during the period of admission and up to the point of cut-off than during any other part of the cycle. (2) Beyond the point of cut-off, the transference of heat continues until the lower pressure due to expansion causes the temperature of the steam to fall below that of the interior surfaces of the cylinder last uncovered. At this point the interchange of heat is reversed, the metal giving up heat to the steam, and causing the re-evaporation of the particles of water condensed on the surface of the cylinder walls and piston. The radiation of heat from the small thicknesses of the interior walls which were heated during admission to the temperature of the entering steam, commences after cut-off or after the pressure begins to lower by expansion, and continues to the end of the stroke.

A portion of the heat is also expended in the performance of work, and a loss of heat is sustained by radiation from those portions of the cylinder not protected by the jacket. The amount of heat remaining after the steam has passed through these operations is that which is rejected by it through the exhaust valve to the atmosphere or to the condenser.

In the case of an internal combustion engine, the total heat of combustion expended in the working of the engine may be divided into three parts: (1) Heat converted into work and represented by indicated or brake horsepower. (2) Heat carried away by the cooling water circulated through the water jacket. (3) The heat lost in the exhaust gases, and through incomplete combustion and radiation.

15. *Heat Converted into Indicated or Brake Horsepower.*—The number of foot-pounds of work done by one pound or one cubic foot of fuel divided by 778, the mechanical equivalent of one British Thermal Unit, will give the number of heat units desired.

16. *Heat Carried Away by the Jacket Water.*—This is determined by measuring the quantity of cooling water passed through the water jacket equivalent to one pound or one cubic foot of fuel consumed, and calculating the amount of heat rejected by multiplying that quantity by the difference of the temperature of the water entering and leaving the jacket.

17. *Heat Rejected in the Exhaust Gases, or Total Heat Unused.*—The sum of the heat converted into brake horsepower and the heat carried away by the jacket water, subtracted from the total heat supplied, will give the total heat rejected or unused.

In order to determine the cost of each horsepower hour in thermal units, the gas consumed and the air supplied should be reduced to the conditions of temperature and pressure corresponding to some adopted standard. This may be done as stated under gas meters in rule 7, or more conveniently by the formula

$$v = \frac{t}{p} \times \frac{v^1p^1}{t^1},$$

in which v = volume of gas reduced to standard; t = 461 + 60 = 521° Fahr., absolute standard temperature; p = 29.92 inches of mercury; v^1 = volume of gas registered by meter; p^1 = pressure of gas at meter measured by manometer in inches of water; t^1 absolute temperature of gas.

Since t and p are constants

$$v = 18.00 \frac{v^1p^1}{t^1},$$

and as p^1 and t^1 are practically constant during a given test, $v = E\ v^1$, in which

$$E = 18.00 \frac{p^1}{t^1},$$

and p^1 = height of barometer + (0.073 × reading of manometer); and t^1 = temperature of gas at meter + 461.

For example: Assume the height of the barometer as 29.40 inches; the reading of the manometer as 6 inches; the temperature of the gas 80° Fahr.; and the volume of the gas registered by the meter 350 cubic feet; then for determining (v) the equivalent volume of gas for standard conditions =

$$p^1 = 29.40 + (0.073 \times 6) = 29.84;$$
$$t^1 = 80 + 461 = 541;$$
$$E = \frac{18.00 \times 29.84}{541} = 0.976;$$

then v = 0.976 × 350 = 341.6 cubic feet.

The air supplied should be metered and reduced to standard conditions in the same manner.

If the rate method is employed to ascertain the amount of gas consumed, the number of cubic feet for a ten-minute interval may be found by dividing the number of cubic feet registered by one revolution of the small dial by the time in seconds elapsed at the completion of that revolution and multiplying the result by 6,000.

18. *Indicated Horsepower* (I.H.P.).—This factor, is expressed by the formula—

$$\text{I.H.P.} = \frac{P \times L \times A \times N}{33{,}000},$$

in which P is the mean effective pressure in pounds per square inch; L the length of the piston stroke in feet; A the area of the piston in square inches; and N the number of revolutions of the engine crank shaft per minute.

$$\frac{A \times L}{33{,}000},$$

is constant for a given engine, and in the case of an internal combustion engine, N is the number of explosions per minute.

19. *Brake Horsepower* (B.H.P.).—When this factor is determined by the use of some form of dynamometer, such as the Prony brake, it may be readily computed from the formula—

$$\text{B.H.P.} = \frac{W \times N \times L \times C}{33{,}000},$$

in which W is the net weight in pounds on the scales; N the number of revolutions per minute; L the length of the lever arm, from the center of the braked wheel to the knife-edge of the brake, or the radius of the braked wheel if a rope brake is used; and C the circumference of the braked wheel.

$$\frac{C \times L}{33{,}000},$$

is constant for a given Prony brake, therefore, if L be made 5¼ feet, this constant becomes 0.001, and gives the simple and very convenient expression—

$$\text{B.H.P.} = \frac{N \times W}{1000}.$$

20. *Total B.T.U.'s Per Hour.*—The total amount of gas consumed, in cubic feet, multiplied by its calorific value.

B.T.U.'s Per Brake Horsepower-Hour.—The total B.T.U.'s per hour divided by the brake horsepower.

B.T.U.'s Per Indicated Horsepower-Hour.—The total B.T.U.'s per hour divided by the indicated horsepower.

Friction Horsepower.—The difference between the indicated horsepower and the brake horsepower.

Thermal Efficiency.—The ratio of 2,545 B.T.U.'s to the B.T.U.'s per horsepower hour.

Mechanical Efficiency.—The ratio of the brake horsepower to the indicated horsepower.

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Engineer Corps, a branch of the service of the United States Navy; and of those of other countries. The first step toward the organization of an engineer corps in the United States Navy was taken on 2 July 1836, when C. H. Haswell (q.v.) was appointed chief engineer of the *Fulton;* it was not, however, until 31 Aug. 1842 that Congress passed an act providing for a regular corps, under which act chief engineers were «commissioned» and assistants «warranted.» On 3 March 1845 Congress passed an act whereby the power of appointing engineer officers was transferred from the Secretary of the Navy to the President «by and with the advice and consent of the Senate.» With the growth of the navy the corps gradually increased till at the time of the Civil War there were 474 regulars and 1803 volunteers.

A course of instruction for cadet engineers was established at the Naval Academy by act of Congress 4 July 1864. The original two-year course was changed to four years in 1874 and continued in vogue till 1882, when on 5 August Congress amalgamated the cadet engineers and midshipmen and they are now known as naval cadets. The cadets then took the usual six years' course at the Academy and upon completion of the third year of the course were divided into an Engineer Division and a Line Division in proportion to the vacancies that have occurred in the several corps during the preceding year. At the end of the six years' course appointments to fill vacancies in the line and in the Marine Corps were made from the Line Division, and to fill vacancies in the Engineer Corps from the Engineer Division. If, after making assignments as above, there should still be vacancies in one branch and surplus graduates in the other, the vacancies in the former were filled by assignment to it of surplus graduates from the latter. This arrangement was in vogue until the Line and Engineer Corps were amalgamated under the act of 3 March 1899, at which time the Engineer Corps ceased to be a separate organization, the older officers now being required to perform engineering duties only, whereas the younger officers must pass examinations in navigation, gunnery, seamanship, etc. A grade of warrant machinists to perform watch duties was also established because of the lack of commissioned officers for this work. See Naval Academy, United States; Navy; Navy of the United States.

Engineering is, in its strict sense, the art of designing, constructing, or using engines, but the word is now applied in a more extended sense, not only to that art, but to that of executing such works as are the objects of civil and military architecture, in which engines or other mechanical appliances are extensively employed. Engineering is divided into many branches, the more important being civil, mechanical, electrical, mining, military, marine, and sanitary engineering.

Among the most notable of the engineering works belonging to very remote antiquity are the pyramids of Egypt. The rude stone monuments of the north, as at Stonehenge and Carnac, also testify to some engineering skill. The harbors and temples of ancient Greece are very memorable. The buildings of ancient Rome — its theatres, temples, baths, and aqueducts, its roads, bridges, and drainage-works, vie in extent and magnificence with the most celebrated works of modern times. From that period down to the commencement of the 18th century the most extensive works executed were the canals, embankments, and other hydraulic constructions used by the Dutch for the purposes of inland navigation, and to protect their low lands from the sea; the canals of North Italy; and the cathedrals and fortifications of mediæval Europe.

If the question were asked as to the characteristic feature of the modern applied science of engineering, the reply would undoubtedly be: «The wholesale manner in which work is carried on.» It is not so very long ago that everything except the smallest articles and those required in great quantity were made singly, or at least in small lots; and even when standardizing and interchangeability were introduced these methods were by no means used in a way which showed a realization of their possibilities. The present tendency, on the contrary, is toward the elimination altogether of things which cannot be made wholesale; and methods which formerly applied to fire-arms, sewing-machines, typewriters, and the like are now in general use in the manufacture of steam-engines, machine tools, electrical machinery, and nearly all mechanical products.

This has been brought about by a combination of two processes: (1) the standardization of methods of manufacture; and (2) the discouragement of the demand for special articles. Formerly the customer told the manufacturer what was wanted, and the latter hastened to produce it. Or the plans and specifications for a certain structure were prepared by a consulting engineer, and all bidders were required to conform to these documents in the minutest details; no two such specifications being alike. At the present time the customer, knowing what he wishes to accomplish, seeks to do so as best he may by means of the standard articles in the market; or if it be a great engineering structure, the engineer specifies only the general requirements to be met, leaving each manufacturer to meet these with his own standardized product. The influence of these modifications in engineering practice extends to the manufacture and supply of materials.

The result of this concentration and standardization has been to reduce costs very materially and render possible undertakings which would otherwise be prohibitory in price. While to a certain extent it has obliterated individuality in design, it has also removed much useless repetition, and has prevented needless expense in the production of rival machines, differing but slightly in design, yet requiring duplications of drawings, patterns, and tools. There is little doubt that it is to this wholesale development of various departments of engineering work that the rapid extension of the share of the United States in the work of the world is largely due. See **Mechanics.**

Engineering, Civil. In order to understand clearly what constitutes civil engineering it will be desirable to consider briefly the steps by which the different engineering professions have been developed and differentiated from one another. The profession of engineering is as old as the most elementary civilization. Up to about the middle of the 18th century there were but two recognized branches of the profession, the civil and the military. The former included all those branches not directly connected with military operations and the construction of fortifications. But the remarkable series of mechanical inventions which distinguished the last third of the 18th century — such as the spinning jenny by Hargreaves, the spinning frame by Arkwright, the mule by Crompton, the power loom by Cartwright, the steam engine by Watt, the puddling process by Cort, and others — followed in the first third of the century just ended by the development of the steam locomotive by Stephenson, the steamboat by Fulton, and by further great improvements in the manufacture of iron and steel, led at length to the differentiation of several branches from the parent stem of civil engineering. Up to that time civil engineering corresponded to what is now the general profession of engineering, and which has probably never been better defined than it was 75 years ago by Thomas Tredgold, as «the art of directing the great sources of power in nature for the use and convenience of man.» The first branch to leave the parent stem was mechanical engineering, followed by metallurgical and mining engineering as the developments in the mining and reduction of metals progressed. Thus it stood till about the middle of the 19th century, since which time the tremendous advance in all branches of applied science has speedily differentiated engineers into the classes named, and into others. For instance, within the last quarter of a century the perfecting of the electric motor and the other great discoveries in electrical science have led to the development of electrical engineering as a distinct profession, the increasing importance of the application of chemistry in manufacturing has produced the chemical engineer, while the advances in sanitary science and the discoveries with reference to the nature, causes, and prevention of disease have resulted in the development of sanitary engineering as a branch quite extensive enough to constitute a profession by itself.

But nothwithstanding the divergence of all these branches, even what is left properly included under the title of civil engineering remains undoubtedly the widest in scope of all the engineering professions, and in practising it a man must become a specialist in some one branch. To enumerate its various fields, it comprises: (a) the construction of railroads, of roads, of street and interurban railways; (b) the improvement of rivers and harbors, the construction of canals, of lighthouses, and other works necessary for carrying on maritime trade and commerce; (c) structural engineering, or the construction of bridges, aqueducts, foundations, steel frames for buildings, etc.; (d) hydraulic engineering, including the development of water powers and the construction of dams and power plants up to the point at which the mechanical engineer is called upon to supply the motors; (e) surveying, which is necessary in the laying out of works of all kinds, but constitutes a branch by itself known as land surveying when applied to the object of measuring and subdividing land, and which is known as topographic surveying when the object is to represent upon a map the surface configuration of the land, and which, further, when extended to the survey of very large areas in which the curvature of the earth must be taken into account, leads to the intricate and interesting problems of geodesy, or the measurement of the earth, and touches upon the field of terrestrial physics; (f) it further includes a great variety of problems due to the congregating of persons in cities, such as works of water supply and sewerage, the drainage of lands and buildings, the disposal of wastes, and the construction and maintenance of city streets and pavements. This last group of problems (f), involving the preservation of the health of communities, is rapidly becoming, if it has not already become, the special field of the new profession of sanitary engineering.

The field of the civil engineer, it is evident, touches at many points the other engineering professions. In the construction and operation of steam railroads and electric railways his work comes in many ways into contact with that of the mechanical and that of the electrical engineer, and the same is true in the development of water powers, the construction of pumping stations, and other work of the hydraulic engineer; while in the problems involved in the construction of the foundations and steel frames for high buildings the civil engineer comes into intimate relations with the architect, with whom he must collaborate. The work of the sanitary engineer also comes in many ways into relation with economic, sociological, and legal problems of importance and difficulty.

We may next inquire as to the qualities which fit a man for success in this profession. In the first place, it is evident that the ideal civil engineer must be a scientific man and at the same time a business man. He must have a thorough knowledge of the laws of nature, the fundamental principles of mathematics and mechanics, and the materials of construction, for his work consists in applying those laws, principles, and materials so as to make them of use in the world's business. He must be essentially a man of action. The engineer takes the discoveries of the scientist in his laboratory or the book-worm in his study, and makes them available for the use and convenience of man. His dominant quality must be practical common sense, combined with habits of care and accuracy, and with the courage and training which will enable him to solve new problems and to meet emergencies with success. His mistakes may be very costly, and his opportunities for effecting economies by skilful design and construction very great.

It is often assumed that in order to be a successful engineer a man must be a fine mathematician. As a matter of fact, while the engineer should be thoroughly familiar with the fundamental principles of mathematics up to and including the calculus, he seldom uses any but the simplest applications. In geometry, and especially in trigonometry, he must be thoroughly at home. I should rather be inclined to say, however, after these explanations, that in order to be a good engineer a man must not be what would usually be called a fine mathematician, or at least that he must in addition possess other mental qualifications which are of far greater consequence; for mathematics is in its essential conceptions and methods an abstract science, and the great mathematician is apt to lack the qualities of action, the quick decision, the accurate judgment, the ingenuity in meeting and overcoming obstacles and the natural grasp and insight leading him to see the physical possibilities of a situation which must distinguish the successful engineer. On the other hand, the engineer should have a liking for mathematics, and a quick and instinctive grasp of its principles and methods, together with the insight which will enable him to see how they are to be made of use, and to use them properly when the time comes.

The training of the engineer must be mainly a training in science, and such a training tends to develop the quality of honesty. The only aim of the true scientific investigator is to arrive at the truth concerning the phenomena he is studying. Such a training, if combined with business ability, makes the very best administrators, and whether for this reason or not, engineers are being more and more sought after to fill administrative positions, especially in connection with corporations in which engineering is concerned. On the other hand, the early practice and associations of the engineer are often of a character which fails to produce polished manners or a good address and appearance, the lack of which is sometimes a great handicap.

There have been, and are, two ways of preparing for the practice of this profession. The first is to begin by getting a thorough technical training, in a good engineering school, in the principles underlying the profession. The second is to begin as an apprentice or student in an engineer's office, gaining experience, and studying at the same time. At the present time it may be stated unhesitatingly that the only proper and safe way to become an engineer is to pursue the first method and secure a preparatory training in one of our engineering schools. In this way the student will learn many things that most men will never learn in practice; he will gain habits of study, breadth of view, and the adaptability which will enable him to meet new problems. Moreover, the young man who aims to become an engineer should secure a broad training, not devoted entirely to technical subjects, but covering also those subjects of a general nature which are necessary for every thoroughly educated man. The engineer of the past has too generally been considered a mere builder, and he has not as a rule been given the position to which his responsibilities and his achievements legitimately entitle him; but the engineer of the future should aim to take a position in society and business as a cultivated and highly trained man, on a level with men in any of the other professions.

The broad and thorough education advised can now be obtained at many schools in this country. Many educators would advise a young man to take first a college course, and to supplement it by a course in a professional school. Another plan, which has its advantages, is to lay out a course longer that the usual college course, in one institution, directed from the beginning toward the end in view, some general subjects and some professional subjects being studied in each year, with an increasing proportion of the latter toward the end of the course. The latter plan has the advantage that the student is working always toward a definite end, provided he is able to decide at the beginning what general line of work he desires to pursue. Some of the technical schools of the United States have provided courses of five years or more, in which the student may gain a technical training and a liberal training at the same time. If a young man is unable to decide upon a profession at the beginning of his course, whether he goes to college first or not, he should at least decide within broad limits, in order that he may arrange his studies so as to avoid unnecessary waste of time when he finds himself able to make a definite choice. It is not at present necessary to go abroad to obtain a technical training in civil engineering. Our American schools now offer better preparation for the practice of the profession in America than can be obtained elsewhere, being well equipped, and teaching American methods. Twenty years ago this could not be said, but at present our technical schools are as good as any in the world. Fortunately, also, many of them offer scholarships or other aids to needy but capable young men, so that the lack of money need not prevent a persevering man from gaining a technical education.

The opportunities presented to a young man graduating from one of our engineering schools will be many and varied. All professions are over-crowded in the sense that there are men in them who cannot find employment, and this is true in civil engineering. Yet there are few professions which offer so many opportunities to properly qualified men, so that, properly speaking, it is very far from over-crowded. The young civil engineer will, moreover, find open to him many purely business positions for which his training will have fitted him. The range of the engineering professions is continually widening, one direction in which they are rapidly extending being that of administration. Within the past 60 years nearly the entire railway system of this country has been built, most of our factories started, and our works of sewerage and water supply constructed. These works have required the services of most of our engineers, while the opportunities of profitable employment here have attracted many members of the profession from foreign shores.

The civil engineer of the past has been mainly a constructor; the civil engineer of the future will be more and more an administrator as well. And while the construction of railroads will not proceed as rapidly in the future as it has in the past, there are certain directions in which construction will proceed with great activity. For instance, although the great era of railroad construction may be said to be substantially ended, there is still much work to be done in building branch lines, in double tracking existing lines, in reducing grades and curves and making other local improvements, often on a large scale. Moreover, the construction of urban and interurban electric lines, for the attainment of rapid transit in cities, and the improvements in steam railroad terminals, is proceeding and will proceed, at a rapid rate, and will require the expenditure of many millions of dollars, while the rapid growth of urban population and the advances in sanitary science have recently given a great impetus to the construction of works for supplying pure water and for disposing of the sewage and other wastes without injury to the public health. Further, it is becoming recognized that the man with common sense and a good technical training, if he have also a talent for organization and executive ability, is the best type of man to direct the work of our great industrial corporations. Some of our large railroad corporations have within comparatively few years instituted the practice of choosing their higher officers from their engineering corps, instead of from other branches of the service. Not a few railroad presidents began their careers as civil engineers, and the number of such men will increase in the future.

The field of the civil engineer, therefore, and the same is true of other branches of the profession, is all the time widening, and widening largely at the top, where there is always room, as well as in the lower ranks. A young man should aim to begin his practical experience at the bottom of the ladder, in whatever line of work he may engage, learning thoroughly every detail of the business.

With respect to financial remuneration, the civil engineer stands at an advantage compared with members of some professions in the fact that his services are in demand at the outset, at a fair salary, while the young doctor or lawyer may not be able to meet his expenses for some years. The ultimate financial possibilities presented to the engineer may not be as great as in the professions referred to, but the rewards are still sufficient to tempt even the most ambitious men, while there are few impecunious engineers. The engineer will be appreciated more and more as time goes on. The profession is a growing one, with great possibilities, and few careers offer greater inducements or a surer or truer success to the energetic and capable young man, for we live in a mechanical age, and the work of the man who can "direct the great sources of power in nature to the use and convenience of man" must continually increase in importance.

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Engineering Education. See EDUCATION, ENGINEERING

Engineering, Electrical. See ELECTRICAL ENGINEERING.

Engineering, Hydraulic. See HYDRAULIC ENGINEERING.

Engineering, Marine, is partly military and partly civil, embracing naval architecture, building and operating of ships and naval accessories. In the military sense, it comprises the construction of war vessels and the construction and placing of torpedoes, submarine mines, etc. See NAVY; NAVAL CONSTRUCTION; SUBMARINE; etc.

Engineering, Mechanical, is that branch of the science and art of engineering which relates specially to machinery. It is closely allied to all other classes of engineering, inasmuch as there is hardly an occupation or industry in which machines of some sort are not directly or indirectly concerned, and it is often, for this reason, difficult to draw the line clearly between one class and the other. The civil engineer who plans and supervises the building of a railroad, calls to his aid the machinery used in excavating, blasting, building masonry, and numberless other mechanical processes required in the work, all of which are the result of mechanical engineering. Electrical engineering would accomplish comparatively little in the production of light and transmission of power were it not for the dynamo and other machinery on which dependence is placed for the manufacture and use of electric current. Mining engineering would be of little use in devising means for extracting the coal and mineral treasures buried in the earth if suitable machinery planned by mechanical engineers could not be employed to assist the labor of men. In marine engineering it is the mechanical engineer who designs the steam plant which produces the motive power for the propulsion of the steamship, and without his assistance there would be no such a thing as a steamship. In dealing with problems relating to waterworks, the hydraulic engineer would be powerless if he could not make use of the pumps and hydraulic machinery which the mechanical engineer has devised. In every kind of industry where power is required, whether it be connected with engineering, architecture, chemistry, agriculture, or any other subject, the mechanical operations involved are based on the continuous operation of the machine constituting the motive power, whether it be a steam engine or water wheel or other motor, and these are the products of mechanical engineering. When we come to fully analyze the subject, therefore, it appears that mechanical engineering so far underlies engineering of every class, and all kinds of industrial operations, that it can almost be said to sustain the whole fabric of modern civilization.

Mechanical engineering, in its strictest sense, relates simply to the design of machines. In its broad sense it covers not only their design but all matters relating to their proper construction and operation. In its common application it has for its scope both the design and construction of machines required for performing certain desired operations, and in addition the design and operation of the complete industrial plant, of which the individual machines form a part, and the construction of the plant in such a manner as to secure a successfully working whole for whatever purposes the plant is built. A large part of the mechanical engineering required at the present day consists in the assembling of machinery to produce certain desired ends, rather than in the design of the machinery itself. In many cases, the machinery has already been designed and constructed by engineers of the past and the perfected machines can be had by purchase in the market. This class of mechanical engineering covers a wide field. Perhaps its scope in this field can best be shown by referring in some detail to a familiar example. Take the case of the engineering required in a large modern hotel. The mechanical plant of such an establishment embraces a great variety of machinery, among the most important of which are the machines and appliances required for power, heating, ventilation, lighting, elevator service, distribution of hot and cold water, fire protection, refrigeration, ice-making, laundry work, and cooking. The work of the engineer, although confined mainly to the mechanical plant, must, at the very outset, be directed to the building itself. The building, no doubt, accords with the modern ideas of construction which call for a framework made of iron, in the design and construction of which the architect must have the assistance of the mechanical engineer. Not only this, but there must be, at the outset, a careful consideration of the required location of the various mechanical appliances, so that in working out the details of design relating to the building the architect may provide the necessary amount of room. He must leave a place for the boilers, engines, dynamos, pumps, etc., which make up the steam plant, and room also for the storage of coal. Provision must be made for the reception of flues, ducts, pipes, and wiring, which pass up through the building and which are distributed here and there to the different rooms. The character of the structures which may be needed for supporting the machinery, and the location of such structures, must also be planned at the outset so that the building may be prepared for them before it is too late. In the design of the mechanical apparatus, one of the first questions for the engineer to consider is the size and character of the steam plant. In dealing with this matter, he ascertains all the uses to which steam is applied, embracing the generation of power, the pumping of water, the supply of steam for all kinds of heating and cooking, and that required for ventilation. With the data thus obtained he determines the total amount of steam required for all purposes, and then calculates the boiler capacity needed to furnish the steam. For the next step, he decides upon the type of boiler best suited for the purpose, whether fire-tube or water-tube, horizontal or vertical, or whether internally or externally fired, and fixes upon the number and size of the units as well as their location. He then makes a plan showing the location of the boilers in the building; the style of the brick setting, if externally fired; the arrangement and location of the smoke flues, and of the stack or chimney to which they connect. Having done this and settled all matters relating to the accessories which form a part of the boiler plant, he takes up, in due course of time, the remaining portion of the work relating to the boiler plant, which may be described at this point because it is representative of much of the work which requires to be done in relation to the other departments of the plant. He draws up specifications describing in full detail the character of the boiler plant desired and what is expected of it as regards capacity and economy. These specifications are submitted to boiler manufacturers who are asked to furnish proposals for the construction of the plant in the manner described. When the proposals of the different bidders have all been received, the engineer examines them, and after consulting with the owner of the property, selects one of the parties with whom to contract for doing the work. Next follows the inspection of the boilers in process of construction in the shop and erection in the building, the object in view being to determine if all the terms of the specifications are complied with. Finally, when the plant is completed and the contractor sets it to work, the engineer submits it to whatever tests may be required, and thereby determines whether the guarantees which have been made regarding the capacity and economy are fulfilled, and whether the plant performs its work with that degree of success and satisfaction that is called for by the specifications. Referring now to the construction of the remaining departments of the mechanical plant, the next thing considered is the motive power. The greater part of the power in such a plant is likely to be transmitted by electricity, and consequently, the motive power is that required for generating electricity. (See ENGINEERING, ELECTRICAL.) After deciding on the number, size, and type of the engines and generators, he must then locate them, and make a plan showing their respective locations with reference to the boiler plant and other parts of the building. At the same time, there must be laid out on the plan a system of steam-piping connecting the boiler to the engines, and this must be arranged with a view to supplying steam to all other points of use, including the heating of the building. Next in order, the pumping machinery requires attention. This embraces the boiler feed pump, the various pumps used for the different classes of hotel work, the elevator pump, if the hydraulic system is employed, and the fire pump. The engineer must determine the proper size of each one according to the amount of water to be pumped, and he must select the type of pump, fix its location, show it on the plan, and extend the system of steam-piping to furnish each with the proper supply. He must also plan the exhaust piping required for each engine and pump, the necessary vent pipe for carrying the waste steam to the atmosphere, and, if exhaust steam is used for heating, the required connection of the exhaust pipe to the main supply of the building. There must be a heater provided in the exhaust pipe system for heating the feed water before it is pumped to the boilers, and another heater for the supply of hot water to the building, and both of these, in their selection, location, and connection, require the careful attention of the engineer. They must be properly laid out and shown on the plan. A complete system of water piping is required, connecting boilers, pumps, hydrants, and elevators, to say nothing of the hot and cold water supply pipes which extend to the various rooms of the hotel, and the location of these must likewise be shown by means of a suitable plan. Not the least important part of the mechanical engineering for the building is the design and construction of the heating and ventilating apparatus. Calculations of the amount of heat and radiating surface needed, the quantity of air required to be changed in a given time, and the sizes of the mains and returns, are involved in this work. Here, also, the kind of the system to be employed, the location and type of the heating and ventilating apparatus, including all the necessary details, are questions which the engineer must consider and decide, and the results must be indicated by proper plans. These various parts of the work are made the subject of detailed specifications, in the manner already referred to, and, likewise, proposals for the installation of the work are obtained, contracts awarded, inspection carried on during construction, and the work tested for acceptance when it is completed, all of which is done under the jurisdiction of the mechanical engineer. In much the same manner, the selection, location, construction, and installation of the remaining parts of the mechanical plant, embracing elevator machinery, laundry machinery, refrigerating machinery, ice-making machines, and the many other appliances concerned in the work of the hotel, are carried out under his supervision.

The same class of mechanical engineering as that referred to in the above example is that involved in the design and construction of industrial plants of various kinds, such as cotton- and woolen-mills, bleacheries, paper-mills, rubber-mills, machinery and other manufactories, this branch of the profession being commonly known as mill engineering. In all of these cases, the elementary parts consist of the power plant, which is sometimes operated by steam, sometimes by water, and often by both, the machines in the mill or manufactory, and the pulleys, shafting, and belting required to transmit the power from the one to the other. The work of the mechanical engineer in these plants consists in properly assembling the various machines so as to perform their functions, the selection of an appropriate power plant, and the proper design and arrangement of the transmitting apparatus required for operating them.

The work of the mechanical engineer is of paramount importance in the construction of steamships. Not only does the design of the boilers and engines on which the whole operation of the ship depends originate with him, but he is also concerned in the design, location, and connection of the multitude of auxiliary steam appliances which abound throughout the vessel and which contribute so much to the comfort of the passengers. The modern steamship is required to contain all the appointments of a first-class hotel. The services of a mechanical engineer are many times more needed in its design and construction than in that of a hotel, for the reason of the contracted space in which the machinery is necessarily enclosed.

One of the most important industries in which the mechanical engineer is a leading figure is that of the steel-rail-mill. Here the plant, which is distributed over many acres of land, embraces immense blast furnaces where the pig iron is made, elevators by which the raw material is lifted to the top of the furnaces, blowing engines which produce the air-blast required at the base of the furnace, converters in which the iron is changed to steel, hydraulic lifts by which the converters are manipulated and the steel blooms moved to cars, trains of rolls with their powerful direct-connected driving engines where the rails are rolled from the masses of white-hot metal, together with their re-heating furnaces, and, in addition to all these, the extensive boiler plants, and the system of piping and other apparatus required for conveying and supplying the boilers with waste furnace gases, on which they largely depend for fuel. The mechanical engineer who lays out and assembles the parts of which such a plant is composed has a task the magnitude of which is commensurate only with the importance of the interests involved.

Since mechanical engineering includes in its scope not only the proper design and construction of machinery but also its satisfactory performance, one branch of the profession relates to the determination, by means of suitable tests, whether the desired performance has been realized. This has especially to do with boilers, engines, and apparatus using steam, which the engineer requires to be installed under specific guarantees of performance. The performance of boilers in the matter of economy is specified in terms of a certain number of pounds of water evaporated per pound of coal, and, in that of capacity, in terms of the number of horse-power developed, while that of the engine is specified as the number of pounds of feed water or dry steam consumed per indicated horse-power per hour. The performance tests require the determination of the quantities stipulated, by actual measurement of the coal, water, and power consumed under working conditions. Another branch of mechanical engineering, in a similar line, relates to the testing of materials used in construction, the object being to determine whether they have the requisite strength and physical characteristics. A sample or specimen of the material is placed in a testing machine and submitted to an actual breaking force and the amount of strain ascertained by measurement.

Having now given some explanation regarding the character of the profession of mechanical engineering, the question naturally arises as to the qualifications needed to make a success of such a profession. It hardly needs to be said of this profession more than of another that the one who adopts it should do so not merely as a means of livelihood, but because his tastes lie in the direction of mechanical pursuits, if, indeed, he does not love the profession for its own sake. No one should enter the profession who is not fond of machinery, who is not a "born mechanic" as the saying is, or who is not deeply interested, to say the least, in every kind of machine. But apart from natural inclinations, there are qualifications that especially fit one for the work of a mechanical engineer. He should have a technical education so as to be thoroughly grounded in the principles of mechanics. He should not only understand these principles but he should know them by heart. He may or he may not remember the formula derived from the principle, but the principle itself should ever be at his finger's end. He should be familiar with mathematics, geometry, and trigonometry. He should know the strength of materials and be able to calculate the strains occurring in structures and in machines, both at rest and in motion, so that he may design them with the proper amount of strength, or, if already designed, that he may be able to prove that they are of sufficient strength for any purpose he may desire to use them. He should know their behavior under varying conditions, and should be able to detect their points of weakness and know the best methods of strengthening them when they fail. He should be a draughtsman and, what is the draughtsman's next neighbor, an inventor. He should know the processes involved in the work of the patternmaker, founder, blacksmith, and machinist. He should know how to erect machinery, and how to operate it after erection. He should know the practices of the trade, and he should know the various articles concerned in mechanical operations which can be bought in the market, and, in a general way, their cost. He should be familiar with the different kinds of engines and boilers, pumps, water wheels, etc., in the market, and their relative advantages. Not the least in importance should he be grounded in the principles of steam engineering and the laws which pertain to the generation and use of steam, not only for the operation of engines of various kinds, but for the various kinds of steam heating. He should be familiar with the steam engine indicator and be able to test a boiler or engine for capacity and economy. He should be well versed in hydraulic, pneumatic, and electrical machinery. He should know about the construction and operation of the various machines of the plant he has assembled, so as to be able to judge of the correctness of their design and construction, and whether they perform their functions in a proper manner, and according to the specified requirements. He should be able to prepare detailed specifications of the work he plans, and he should possess sufficient literary ability to draw up a suitable report upon any question that may arise regarding the work he is called upon to perform, and pass judgment upon the comparative merits of different makes of machines required for a given purpose or of the different modes of carrying on given processes. In a word, the mechanical engineer must be skilled by observation, by study, and by experience in the science and art of the profession from beginning to end.

One of the leading problems confronting the mechanical engineer, whatever the special line in which he is engaged, is the reduction in the cost of production, and, what is allied to it, the attainment of the maximum result from machinery with the least expenditure of money, time, and labor. As machines and processes are in a continual state of improvement, and almost all lines of business are in a continual state of growth, it does not require many years to elapse after a piece of engineering work has been completed before it must be remodeled or enlarged to meet the demands of the times. This problem of reducing the cost of production is, therefore, one which is continually before him. In the design of an individual machine, the highest aim is to reduce the number of parts and quantity of material used to the smallest amount consistent with proper operation, and to run it at the highest speed which can be safely and successfully maintained. In arranging a plant for carrying on some industrial process, the aim must be to employ machinery wherever it is possible to save the labor of men, and assemble the machines so that the least number of hands and the least expense is required to change the raw material into the finished product. Following in the same direction is the aim to save all unnecessary waste of fuel or energy required in operating the machinery, whatever the class of work and in whatever department of the work such waste may occur.

There are many notable problems of a more specific nature than the one just named which absorb the attention of mechanical engineers and await their solution. One of these is the reduction in cost of steam power. Owing to the great amount of heat which passes to waste through the escaping of exhaust steam to the atmosphere or to the condenser, amounting in the most economical engines to no less than three fourths of that required in the original generation of the steam, there is a wide field for improvement in steam engine economy. Efforts are being made to reduce this waste by employing a part of the heat thus lost for evaporating some other liquid having a sufficiently low temperature of evaporation, and using the vapor thus formed to generate power in an auxiliary cylinder, thereby adding to the total power developed by the engine, and reducing in a corresponding degree the cost of the power per horse-power. Another problem of the same kind is the substitution of some other motive power for the steam plant with the object of reducing its cost. Gas, oil, and other forms of internal combustion engines are being widely developed for this purpose. In the conversion of coal into gas by the employment of a gas producer, and the subsequent use of the gas in the cylinder for developing power, the cost has already been reduced below that of steam power, and even better results may be expected.

The development of the steam turbine and its substitution for reciprocating engines is one of the problems on which mechanical engineers are most diligently working. The advantages to be obtained from this form of engine are the reduced space, increased speed of revolution, and greater uniformity of rotation which the turbine principle secures. There is a special field for its use in the operation of electric generators and in the propulsion of steamships, in both of which there is promise of most efficient results. The belief prevails that in the proper application of the turbine engine to marine work will be found the solution of the problem of rapid transportation by water.

Another great problem of mechanical engineering which is of importance to all business interests, is that of rapid transportation by railroad. The excellent results that have already been accomplished in this direction on short lines of suburban travel are due to the application of electricity, and the wide introduction of the electric railroad makes this a familiar subject to everyone. On steam railroads the efforts for increasing speed on long lines of travel do not lie in the direction of any radical departure from existing practices, but rather in the perfection of details whereby locomotives of greater power and cars of better construction are employed, the road-bed improved, and all the various details of railroad travel arranged so as to secure the most expeditious handling of trains. How best to provide a marked increase of speed on railroads, whether by the application of electricity, or by some new and untried method, is one of the problems still unsolved.

The great problem of aërial navigation is one which naturally lies in the domain of mechanical engineering. Although much has been done experimentally in this field, and there are instances of air-ships being constructed and successfully propelled for short distances at low speed, the practical solution of the problem has thus far baffled all efforts. One of the most encouraging experiments has been made by using a suitably shaped balloon and employing a gasoline engine connected to screw propellers for motive power; the engine being of high power in proportion to its weight, and the steering being effected by a rudder. Experiments have also been conducted with aëroplanes, in the hope of obtaining through these devices the necessary supporting power for the weight to be carried, and thereby dispensing with the use of balloons. With the same end in view, the motion of the wings of large birds has been studied for the purpose of determining the natural laws which govern aërial travel, and, if possible, copying them. In neither of these lines has much success been attained.

There are other great problems of mechanical engineering, yet unsolved, which relate to the production of power by the employment of the forces of nature not heretofore utilized. One of these has for its object the utilization of the sun's heat. It has been worked out in a small way in California. A concave mirror having 1,000 square feet of surface has been employed for converging the rays of the sun upon a steam boiler which lies at its focus, and suitable mechanism is arranged for keeping the mirror always turned in the proper direction toward the sun. It is said that in full sunshine this apparatus has developed 10 horse-power. Wind power is widely and successfully employed on a small scale, but there remains the problem of overcoming its variable nature by providing means for storing it, and of applying the power thus obtained without limitations. The development of tidal power, like that of wind power, is largely a problem of the storage of energy, and no success in this field has been realized.

What the future offers to a young man choosing the profession of mechanical engineering depends very much upon the ability of the man himself. The broad scope of the profession, already referred to, furnishes ample indication that there is a wide field of work for him. That there are positions awaiting the young engineer may be seen by examining the catalogues of prominent technical colleges, which record the names of graduates and their occupations. Referring to one of these catalogues, and taking as a sample the last graduating class given, that for the year 1902, there are recorded a total of 44 mechanical engineers. Of this number only 3 are put down without employment, and 1 of the 3 is in reality employed, being a graduate student. Of the 41 holding positions, 18 are engaged in various engineering occupations connected with the manufacture of machinery, 3 are employed in textile mills, 8 are engaged in steel works, 3 are connected with railroads, and the remaining 9 are variously occupied in engineering pursuits. If the young engineer becomes connected with an industrial business of sufficient size and importance to warrant the steady employment of a mechanical engineer, and he shows the necessary ability, the prospect is that he will in time push forward to a position of responsibility which will command a good salary and satisfy any ordinary ambition. If his desire is to establish an engineering business of his own, he can make the emoluments greater than in a salaried position, provided he is able to secure the necessary clientage, and conduct such a business to advantage. If this is his choice, the most promising course for him to pursue is to first enter the office of a successful engineer, and spend a few years in learning the business. Then, if he has the acquaintance and aptitude necessary for attracting business for himself, he can set up his own establishment, and by careful attention to the execution of his work strive for the success he seeks. In mechanical engineering, as in other professions, large emoluments await the men who rise to the top, for these are the engineers who are called upon by individuals and corporations for consultation.

The profession of mechanical engineering offers as many attractions to those entering it as any other profession, for in this, as in others, there is always room for those who excel, and no professional man meets with success unless his work commands it.

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Engineering, Military. The duties of the military engineer consist in the construction of fortifications, including the trenches and batteries required in besieging places; also of barracks, magazines, of roads and bridges to facilitate the passage of an army. He should have a practical and theoretical knowledge of gunnery. In this country he is often called upon to undertake works which more properly belong to the business of a civil engineer, such as the survey of the country, the inspection of public works, in fact, all the duties of a government engineer. See GUNNERY; ORDNANCE; WAR; etc.

Engineering, Mining. See MINING ENGINEERING.

Engineering, Sanitary. See SANITARY ENGINEERING.

Engineering Education. Interesting statistics have been prepared showing the work of students in technical schools in the United States, as compared with the work of students in other countries. The following comparative table gives the percentage number of hours' instruction at Massachusetts Institute of Technology, Cornell, the Berlin Technical High School and the Zürich Polytechnicum that are devoted to each group of studies:

STUDY	M. I. T.	Cornell	Berlin	Zürich
Mathematics	8	5	14.5	19.2
Physics	5	8	6.8	6.0
Chemistry	7	7	1.7	3.0
Applied mechanics	7	10	22.5	19.5
Mechanism	4	......	8.0	......
Steam Engine; Thermo-dynamics	6	6	4.1	8.0
Mechanical, etc., Drawing	26	20	31.0	39.3
Electrical Engineering	2	2	3.4	5.0
Commercial subjects	2	......	8.0	......
Workshop practice	14	30	......	......
French	6	......	......	......
German	3	3	......	......
English	5	......	......	......
Engineering Laboratory	5	9	?	?
	100	100	100	100
Approximate hours	3000	3000	4000	4000
Course in years	4	4	3	3

Marked differences in theories of training is evidenced in these curricula. The American courses are more practical in character and require more laboratory training than is even recommended in the German plan, and they devote a large proportion of the time to teaching skill in handicraft. They give much less time to mathematics, and perhaps there may be a loss of power in mature life on this account, though it is certain that immediate and practical ends are gained by the American programme. See EDUCATION, ENGINEERING.

Engineering Instruments are principally the rod, compass, level and transit. See INSTRUMENTS, ENGINEERING; SURVEYING.

Engineering Schools. The education and training of the engineer in modern times have called for the establishment of technical schools and courses in engineering in the large colleges and universities. These schools provide the student with the theories of mathematics, mechanics, and engineering, and by means of extensive laboratory and outside work provide him with practice in the design, construction, and use of modern engineering appliances. Among the most noted technical schools are the University of Glasgow; Ecole Polytechnique, in Paris; Stevens Institute of Technology, in Hoboken, N. J.; the Massachusetts Institute of Technology, in Boston; and Cornell and Columbia universities. See EDUCATION, SCIENTIFIC AND TECHNICAL.

Engineering and Structural Terms. The following list includes some of the principal terms applied to designate the various mechanical units employed in engineering and structural operation, See also ENGINE; LOCOMOTIVE, DESIGN AND CONSTRUCTION OF THE MODERN; and WORKSHOP TERMS.

ABUTMENTS.— In structural work — the surfaces which support arches, beams, and bridges, and sustain the reactions due to the application of the load. In machinery — any relatively immovable part or surface designed to resist pressure, or to resist reaction. In carpentry — a joint of two pieces, the fibres of one being at right angles with those of the other.

ACTION.— The manner in which a machine or engine works. In mechanics it is axiomatic, that action and reaction are equal and opposite.

ACTUAL OR AVAILABLE HORSE-POWER — A.H.P.— See BRAKE HORSE-POWER.

ANNULAR.— Ring-shaped — as the annular seating or circular seating on which a pump valve rests; or the cylinder and piston of an annular engine.

APEX.— The point or summit of a cone, pyramid, or any triangular-shaped structure or figure. In engineering — the points of the triangles in truss girders, or those portions of the braces which intersect the flanges at the top and bottom.

AXIS.— The line which passes through the centre of a body. The axis of a cylinder, or of a sphere, is the right line which passes through the centres of all the corresponding parallel sections thereof. The axis of an ellipse, a parabola, or a hyperbola is the right line which divides the curves symmetrically. The "axis of symmetry" is an imaginary central line around which a symmetrical body is developed, and which passes through the centre of gravity of the body. The "neutral axis" of a beam is a longitudinal central line along which a beam is neither in tension nor compression. In a beam of uniform section it corresponds with the central line of the cross-section. In beams of varying section it corresponds to the mean of the bending sections.

BALANCE.— The equilibrium or equality of the moments, or the equality of the sum of the forces which tend to move or turn a body in one direction, to the sum of the forces which tend to move or turn it in the opposite direction.

BELT OR BELTING.—A band or strap of leather, india-rubber, or cotton, employed to transmit power over smooth pulleys. Belts act by friction only, and are extensively employed where an exact velocity ratio is not essential, and where the distance between the shafts prevents the employment of a positive means of transmission. The transmitting capacity of a belt depends upon its pull, or upon the lineal velocity at which it travels. The amount of pull depends upon the strength of the belt and the friction on the pulleys. The lineal velocity depends upon the diameter of the pulleys and upon the speed of revolution. Belts are also extensively used as conveyors of material such as coal, ores, grain, and finished products, in mining, milling, and manufacturing plants. They are made in a great variety of sizes both for power transmission and conveying purposes and range from 5 to 60 inches in width, and from 5 to 300 feet in length.

BELT TENSION.— The ultimate strength of belts ranges from 2,000 to 5,000 pounds per square inch, but these values are greatly reduced at the joints. At the laced joints, it ranges from 1,000 to 1,500 pounds, and at the riveted joints, from 1,500 to 2,500 pounds per square inch. The working tension usually maintained ranges from 30 to 60 pounds per inch of width.

BENDING MOMENT.— The sum of the external forces which act upon each side of a given section of a beam bending under a load. It is equal to the "moment of resistance" of that section, or the sum of the internal forces or stresses set up therein by the bending action.

BLOCKING OR BLOCKING-UP.— The elevating and supporting of large pieces of machinery, or entire structures, by means of cranes, jacks, and blocking or short lengths of timber and planks, during erecting and constructing operations. It is also applied to the elevation given to the outer rail of the curve of a railway track, for the purpose of counteracting the effect of the centrifugal force developed by a rapidly moving train.

BOLT.—A metal device employed by engineers for fastening purposes. Bolts are usually made of wrought-iron or of mild steel. In the ordinary forms, the head is forged with the shank, and the opposite end or tail is threaded to receive the screw nut by which it is secured. The heads and nuts are made either rectangular or hexagonal, and the shoulder or neck under the head is often made rectangular so as to fit into a square hole and thus prevent the bolt from turning around on its axis. For general purposes, the dimensions of bolts conform to certain standards. The United States standard is conformed to in America, and the Whitworth standard, in Great Britain and other European countries.

BRAKE HORSE-POWER — B.H.P.— The amount of power delivered by an engine at the driving pulley or power shaft, and actually available for doing work. The power developed by an engine is measured at two points — at the cylinder, as indicated horse-power, and at the driving pulley. Between the cylinder and the pulley a certain amount of power is lost in the friction developed in the running of the engine itself, so that the actual horse-power available for work is the indicated horse-power minus the horse-power lost in friction. It is sometimes expressed — D.H.P., delivered horse-power.

BRITISH THERMAL UNIT — B.T.U.— The amount of heat required to raise the temperature of water one degree Fahrenheit, at or about 39.1° Fahrenheit. Its mechanical equivalent as originally determined by Joule is 772 foot-pounds, but later determinations indicate that it is nearer 778 foot-pounds. To convert values of energy expressed in foot-pounds to their equivalents in British Thermal Units, divide the values by 778.

CAMBER.— The amount of upward curvature given to an arched bar or structure in order to compensate for the downward curvature resulting from the application of the load. In machinery, it is specifically applied to the arching of springs like those of locomotives. In structural work, it is applied to the arching of bridge trusses like the stiffening trusses of suspension bridges.

CANTILEVER.— A beam fixed at one end and loaded at the other, or loaded uniformly. In ordinary structural work it is represented by the brackets employed for supporting balconies or other overhanging platforms like the sidewalks placed on the outside the trusses of a bridge.

CENTRE.— The fixed point about which the radius of a circle or of a circular arc moves. It is extensively applied as a specializing prefix to other terms, as "centre gauge," "centre line," etc. The "centre of compression" is the line in which the resultant of the compressive forces in the lower part of a beam is located. The "centre of gravity" is the point in a body about which the body will remain balanced when placed in any position. The "centre of gyration" is the point in which the momentum of a revolving body is concentrated. The "centre of moments" is the point about which the forces applied to a rigid body act. The "centre of oscillation" is the point in the axis of a vibrating body, such as a pendulum, in which if all the matter of the body were concentrated, the body would vibrate in the same time. The centre of gravity and the centre of oscillation lie in the same axis, but the latter is located farther from the point of suspension. The "centre of percussion" is the point in a revolving body at which if the body struck an immovable obstacle, would result in the destruction of all of its motion. The "centre of tension" is the line where the resultant of the tensile forces in the upper part of a beam is located.

Circular Inch.— The area of a circle one inch in diameter, as distinguished from a square inch. The number of circular inches in a given diameter is obtained by squaring the diameter.

Coefficients.— Numerical values deduced from data obtained by experiments and used as constant multipliers in engineering calculations. They have been determined for friction, elasticity, tension, rupture, resistance, the flow of water, etc. For example — the amount of force or weight that will elongate an elastic bar of any material and of uniform section to twice its original length is designated as the "coefficient of elasticity" of that material. Also termed "modulus," as the "modulus of elasticity," the "modulus of resistance," etc.

Cohesive Strength.— The resistance of a material to rupture under tension. The same as "tensile strength," and equivalent to "tenacity."

Column.—A beam set on end and receiving pressure vertically or in the direction of its longitudinal axis. The latter condition, however, varies with the length of the column. When the length is 25 to 30 times greater than the diameter, it is a "long column," and yields under pressure by bending only, in a manner similar to that of a beam supported at both ends. When the length is 3 to 5 times greater than the diameter, it is a "short column," and ruptures by crushing only. The resistance of a column to flexure is increased by flattening its ends, by extending the area of the ends, and by firmly fixing both ends.

Compound Machines.— Those which are designed and adapted for performing several different kinds of work, either simultaneously, or at different periods of time.

Complement.—A term employed in angular measurement. The complement of an angle is its difference from 90°.

Compression.—A term of various applications. A body is in compression when it is subjected to crushing forces which act in the direction of the axis which is continuous with the direction of pressure. The cushioning or resistance of the steam in the end of an engine cylinder to the return stroke of the piston. The pressure exerted on the explosive charge in the cylinder of a gas engine by the piston during its instroke previous to "ignition" of the charge.

Concentrated Load.—A load localized or applied at a particular point upon a beam, girder, or structure. A concentrated load will produce twice as much stress as a distributed load.

Constant.—A number deduced from data obtained by actual tests made upon the strength of a particular material, and used in calculations relative to the strength of structures built of that material. For example — having ascertained by actual experiment the weight required to rupture a steel bar measuring 3 x 2 x 1 inches, that weight can be used to estimate the stresses in structures made of the same material but differing in length, breadth, and depth.

Country Cut.— Timber or lumber which has been sawn into planks and boards in the district where the trees were felled.

Couple.— Two equal and opposite forces acting upon a body, which is, therefore, in a state of equilibrium.

Creeping.— The slight loss of speed due to the slipping of the rope in the case of drums driven by rope gearing, and by the elasticity of the belts in the case of power transmitting belting. In either case the amount is very small per revolution, or for short intervals of time.

Dangerous Section.— The section of a bar at which the bending moment is greatest.

Datum or Datum Line.—Any base line from which measurements are made, or dimensions taken, either in actual work, or in graphical calculations.

Deals.— Sawn timber which usually measures not less than 3 x 9 inches and not more than 3 x 12 inches in cross-section.

Differential Motion.— The motion resulting from the combination of the different motions of two parts of a mechanical device. It affords mechanical gain. For example — in the combination of the wheel and axle commonly called the "Chinese Windlass," two axles of unequal diameters rotate together so that the rope which passes through the movable pulley which supports the weight is wound up on the larger axle and unwound on the smaller axle. The upward movement of the weight is consequently very slow, but the mechanical gain is very great. In the case of the "differential screw," two screws of unequal pitch are cut on the same spindle. When the spindle is turned, a nut on one of the screws is moved by an amount equal to the difference in the pitches. A "differential strain" is one that is due to a variable load.

Double Gear.— Gearing in which two wheels and two pinions are used. The arrangement affords mechanical gain. The principle is extensively employed in connection with the gear of lifting cranes, drilling machines, lathes, etc.

Driven.—As applied to gearing, it refers to the wheel or wheels actuated by the "driver" or wheel attached to the driving shaft. To calculate the mechanical efficiency of a train of gearing, multiply the radii of all the drivers together, and likewise the radii of all the driven, and divide the latter by the former.

Duty.— The performance or amount of work done by an engine as determined upon the basis of coal consumption, and stated in foot-pounds. The duty of a steam engine is the number of pounds raised to the height of one foot by the burning of a bushel of coal. In the case of pumping engines, the duty was formerly expressed in millions of pounds of water lifted to the height of one foot by the burning of 100 pounds of coal; but, as the quality of coal varies greatly, the basis now employed is the work done by 1,000 pounds of dry steam, or by 1,000,000 British Thermal Units.

Efficiency.— The efficiency of a machine or of a structure, or any portion thereof, is the ratio of its strength, power, or capacity, to that of some predetermined, understood, or fixed standard of reference. For example — the efficiency of a riveted joint in plate work is its percentage strength calculated relatively to that of the solid plate. The efficiency of a machine is the ratio of its actual value to its theoretical value, or the difference between the amount of work expended on the machine and the amount given out by it or obtained from it.

Encastre.— The immovable fixing of the ends of a cantilever, or the ends of other forms of beams or girders in a wall or support. Beams are much stronger when encastre than when simply supported.

Factor of Safety.— When calculating the ultimate strength of a structure it is necessary to provide for contingencies arising from a lack of uniform quality in materials, inferiority of materials, wear and tear of parts, the unexpected application of loads, etc. This provision is made by the use of multipliers such as 4, 6, 8, and in some cases 10, which are applied to certain dimensions. For example — the application of a factor of safety of four will give a structure having four times the strength necessary to carry the load it will be ordinarily required to sustain.

Graphic Statics.— The graphical methods employed for ascertaining the strains on structures, velocity ratios, etc.; by means of lines drawn to an uniform scale and representing the direction and intensity of active forces.

Hollow Structures.— The frames, standards, and parts of large machines and structures, made hollow from motives of economy, or to reduce their weight while retaining their strength. They are represented by the various forms of box girders, base plates, columns, etc.

Horse-Power.— A term used for expressing the power developed by a mechanical motor or engine. It was originally selected by James Watt as a basis on which to sell his engines. One horse-power is a quantity of work equivalent to that which is expended in raising a weight of 33,000 pounds to the height of one foot in one minute, or a weight of 550 pounds to the height of one foot in one second. It is expressed in foot-pounds, and is designated as A.H.P.— Actual or Available Horse-Power, or B.H.P.— Brake Horse-Power; N.H.P.— Nominal Horse-Power, a comparatively obsolete term used by some manufacturers to designate the size of an engine; I.H.P.— Indicated Horse-Power, the foot-pounds of work done behind the piston; and F.H.P.— Friction Horse-Power, the number of foot-pounds of power lost by the friction of the engine.

Interchangeable.—Applied to the parts of machines and structures which are made similar and in large quantities, so that a part taken from one may be used in any other of the same size and type.

Mean Effective Pressure.— The power exerted by the expansive energy of a gas in driving the piston of an engine. Being variable for different positions of the piston, the value determined is the average of the pressures at the various positions. It is usually determined by the use of an indicator or pressure gauge diagram.

Thermal Efficiency.— The ratio of the heat converted by an engine into mechanical energy, and the heat absorbed by it from the source of supply. It is limited by the range of temperature through which the working substance within the cylinder acts, and must be always a quantity less than unity.

Traction of Tractive Power.— The pulling power afforded by the frictional adhesion of wheels.

Ultimate. Strength.— The strength of a material equivalent to the load which produces actual fracture. The ultimate strength as determined by actual test is usually employed in engineering calculations in preference to the elastic strength, as it affords data of a more definite character.

Units.— Mechanical units are of two classes — those derived from the relations of things having their basis in natural law, and those consisting of conventional standards adopted for convenience in calculations. For example — the Joule, the unit of heat, is based upon a natural and interchangeable fact. while the horse-power is simply a conventional standard accepted by engineers by mutual consent and use.

Velocity Ratio.— The proportional velocity of bodies which are mutually connected, such as levers, gear-wheels, etc.

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Engineers, Corps of, a branch of the military service of the United States, organized in 1802, as «The Corps of Engineers of the United States Army.» There are similar organizations in all European countries. See Army; Army of the United States.

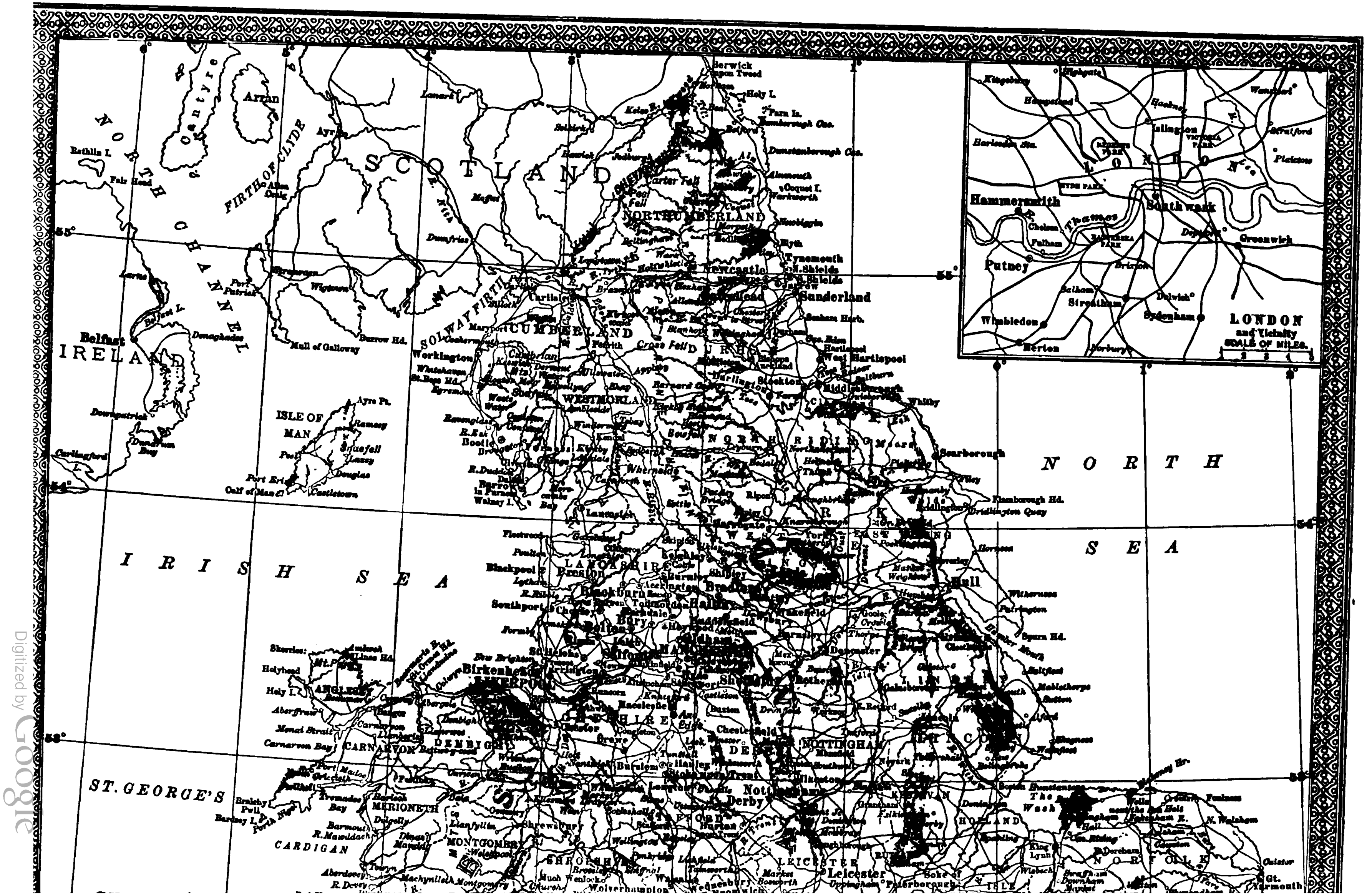
Engis, ŏṅ-zhē, Belgium, an archæological station on the Meuse, southwest of Liège, where a human skull was found imbedded in breccia, with remains of the rhinoceros and reindeer. There has been much discussion among archæologists as to the age of the skull, but it is most commonly referred to the Quaternary Period.

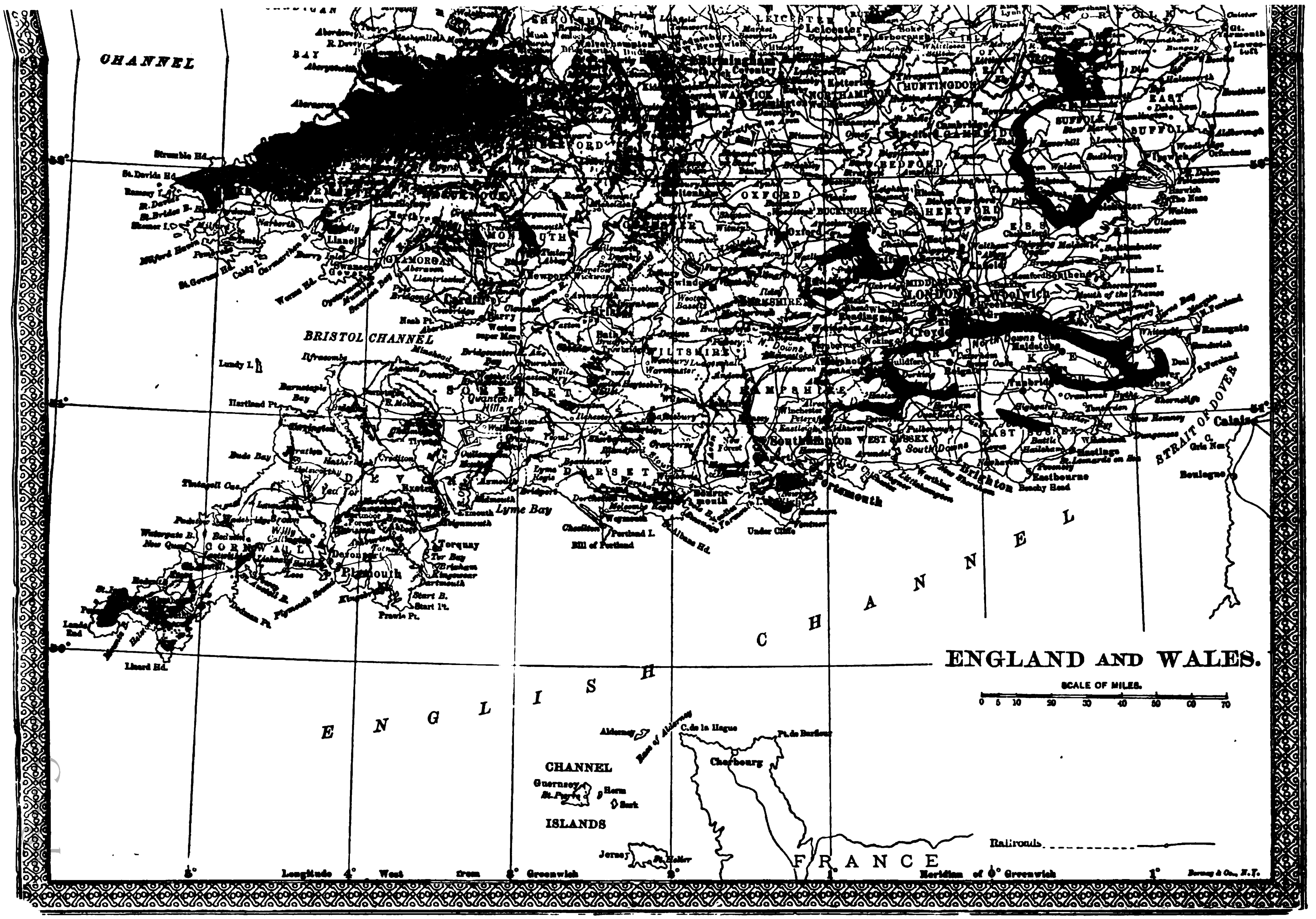
England, including **Wales,** the southern and larger portion of the island of Great Britain, is situated between lat. 50° and 55° 46′ N. and lon. 1° 46′ E. and 5° 42′ W. On the north it is bounded by Scotland; on all other sides it is washed by the sea; on the east by the North Sea or German Ocean; on the south by the English Channel; and on the west by St. George's Channel and the Irish Sea. Its figure is, roughly speaking, triangular, but with many windings and indentations, the coast-line measuring not less than 2,765 miles. The length of the country, measured on a meridian from Berwick nearly to St. Alban's Head, is 365 miles. Its breadth, measured on a parallel of latitude, attains its maximum between St. David's Head, in South Wales, and the Naze, in Essex, where it amounts to 280 miles.

Topography.— The chief indentations are: On the east, the Humber, the Wash, and the Thames estuary; on the west, the Solway Firth, Morecambe Bay, Cardigan Bay, and the Bristol Channel; those on the south are less prominent, though including some useful harbors. The greater part of the coast consists of cliffs, in some places clayey, in others rocky, and sometimes jutting out into bold, lofty, and precipitous headlands, as at Whitby and Flamborough Head on the east, Beachy Head, the Isle of Portland, the Lizard and Land's End on the south and southwest, St. David's Head and St. Bees Head on the west. The most extensive stretches of flat coast are on the east, in the county of Lincoln, and from the south part of Suffolk to the South Foreland in Kent, and in Sussex and Hants on the south coast. The chief islands are: Holy Island, the Farne Islands, Sheppy, and Thanet on the east coast; the Isle of Wight on the south; the Scilly Isles at the southwestern extremity; and Lundy Island, Anglesey, Holyhead, and Walney on the west.

The loftiest heights of England and Wales are situated at no great distance from its west shores, and consist of a succession of mountains and hills, stretching, with some interruptions, from north to south, and throwing out numerous branches on both sides, but particularly to the west, where all the culminating summits are found. The northern portion of this range has received the name of the Pennine Chain. It is properly a continuation of the Cheviot Hills, and, commencing at the Scottish border, proceeds south for about 270 miles, till, in the counties of Derby and Stafford, it assumes the form of an elevated moorland plateau. In Derbyshire The Peak rises to the height of 2,080 feet. By far the most important of its offsets are those of the west, more especially if we include in them the lofty mountain masses in northwestern England sometimes classed separately as the Cumbrian range. Amid these mountains lie the celebrated English lakes, of which the most important are Windermere, Derwent Water, Coniston Lake, and Ullswater. Here also is the highest summit of northern England, Sca Fell (3,210 feet). The Pennine Chain, with its appended Cumbrian range is succeeded by one which surpasses both these in loftiness and extent, but has its great nucleus much farther to the west, where it covers the greater part of Wales, deriving from this its name, the Cambrian range. Its principal ridge stretches through Carnarvonshire from north and west, with Snowdon (3,571 feet) as the culminating point of south Great Britain; across the Bristol Channel from Wales is the Devonian range. It may be considered as commencing in the Mendip Hills of Somerset, and then pursuing a southwest direction through that county and the counties of Devon and Cornwall to the Land's End, the wild and desolate tract of Dartmoor forming one of its most remarkable features (highest summit, Yes Tor, 2,050 feet). Other ranges are the Cotswold Hills, proceeding in a northeast direction from near the Mendip Hills; the Chiltern Hills taking a similar direction farther to the east and the North and South Downs running east, the latter reaching the southern coast near Beachy Head, the former reaching the southeast coast at Folkestone.

A large part of the surface of England consists of wide valleys and plains. Beginning in the north, the first valleys on the east side are those of the Coquet, Tyne, and Tees; on the west the beautiful valley of the Eden, which, at first hemmed in between the Cumbrian range and Pennine Chain, gradually widens out into a plain of about 470 square miles, with the


SCOTLAND
IRELAND
NORTH CHANNEL
FIRTH OF CLYDE
SOLWAY FIRTH
IRISH SEA
NORTH SEA
ST. GEORGE'S
ISLE OF MAN
Arran
Cantyre
Rathlin I.
Fair Head
Belfast
Belfast L.
Donaghadee
Downpatrick
Dundrum Bay
Carlingford
Ayr
Lanark
Moffat
Dumfries
Stranraer
Wigtown
Mull of Galloway
Burrow Hd.
Port Patrick
Ailsa Craig
Ayre Pt.
Ramsey
Snaefell
Laxey
Douglas
Peel
Port Erin
Calf of Man
Castletown
Berwick upon Tweed
Holy I.
Farn Is.
Bamborough Cas.
Dunstanborough Cas.
Alnmouth
Coquet I.
Warkworth
Newbiggin
Blyth
Tynemouth
N. Shields
S. Shields
Newcastle
Sunderland
Seaham Harb.
West Hartlepool
Stockton
Middlesbrough
Darlington
Whitby
Scarborough
Flamborough Hd.
Bridlington Quay
Hornsea
Hull
Withernsea
Patrington
Spurn Hd.
Saltfleet
Mablethorpe
Sutton
Skegness
Wainfleet
Boston
The Wash
King's Lynn
Wisbech
Gt. Yarmouth
Ormesby
Foulness
Walsham
Aylsham
Dereham
Swaffham
Downham Market
Hunstanton
NORTHUMBERLAND
CUMBERLAND
WESTMORLAND
DURHAM
NORTH RIDING
WEST RIDING
EAST RIDING
YORK
LANCASHIRE
CHESHIRE
DERBY
NOTTINGHAM
LINCOLN
LEICESTER
RUTLAND
STAFFORD
SHROPSHIRE
DENBIGH
CARNARVON
ANGLESEY
MERIONETH
MONTGOMERY
CARDIGAN
NORFOLK
HOLLAND
KESTEVEN
Carlisle
Penrith
Cross Fell
Workington
Maryport
Cockermouth
Whitehaven
St. Bees Hd.
Egremont
Keswick
Ravenglass
Bootle
Barrow in Furness
Walney I.
Lancaster
Fleetwood
Poulton
Blackpool
Lytham
Preston
Blackburn
Southport
Chorley
Bolton
Bury
Rochdale
Oldham
Manchester
Stockport
St. Helens
Liverpool
Birkenhead
New Brighton
Warrington
Wigan
Halifax
Huddersfield
Bradford
Leeds
Wakefield
Barnsley
Sheffield
Rotherham
Doncaster
Goole
York
Ripon
Settle
Skipton
Keighley
Shipley
Harrogate
Knaresborough
Malton
Pickering
Thirsk
Northallerton
Barnard Castle
Bishop Auckland
Chester-le-Street
Hexham
Morpeth
Bellingham
Alnwick
Wooler
Kelso
Selkirk
Hawick
Jedburgh
Carter Fell
Macclesfield
Congleton
Crewe
Buxton
Chesterfield
Mansfield
Newark
Nottingham
Derby
Burslem
Hanley
Stoke upon Trent
Stafford
Lichfield
Tamworth
Wolverhampton
Shrewsbury
Wellington
Much Wenlock
Market Bosworth
Leicester
Uppingham
Peterborough
Grantham
Gainsborough
Lincoln
Spalding
Welshpool
Montgomery
Machynlleth
Aberdovey
R. Dovey
Barmouth
Dolgelly
Bala
Festiniog
Tremadoc Bay
Port Madoc
Criccieth
Pwllheli
Bardsey I.
Carnarvon Bay
Menai Strait
Aberffraw
Holyhead
Holy I.
Amlwch
Beaumaris
Bangor
Conway
Llandudno
Abergele
Denbigh
Llanrwst
Llanfyllin
Skerries
Wrexham
Chester
Ellesmere
Oswestry
Runcorn
Northwich
Nantwich
Knutsford
LONDON and Vicinity
SCALE OF MILES
1 2 3 4 5
LONDON
Kingsbury
Highgate
Hampstead
Hackney
Islington
Victoria Park
Wanstead
Stratford
Plaistow
Harlesden Sta.
Regents Park
Hyde Park
Hammersmith
Southwark
Chelsea
Fulham
Battersea Park
Thames
Deptford
Greenwich
Putney
Brixton
Balham
Streatham
Dulwich
Sydenham
Wimbledon
Merton
Norbury
55°
54°
53°
6°
5°
4°
3°
2°
1°
0°


ENGLAND AND WALES.
SCALE OF MILES.
0 5 10 20 30 40 50 60 70
Railroads
ENGLISH CHANNEL
BRISTOL CHANNEL
CHANNEL
BAY
STRAIT OF DOVER
CHANNEL ISLANDS
Alderney
Race of Alderney
Guernsey
St. Peter
Herm
Sark
Jersey
St. Helier
FRANCE
C. de la Hague
Cherbourg
Pt. de Barfleur
Calais
C. Gris Nez
Boulogne
OXFORD
BUCKINGHAM
HERTFORD
BEDFORD
HUNTINGDON
NORTHAMPTON
WARWICK
SUFFOLK
EAST SUFFOLK
ESSEX
MIDDLESEX
LONDON
Croydon
KENT
EAST SUSSEX
WEST SUSSEX
Brighton
Hastings
Eastbourne
Beachy Head
Southampton
Portsmouth
South Downs
N. Downs
HAMPSHIRE
BERKSHIRE
WILTSHIRE
SOMERSET
DORSET
DEVON
CORNWALL
GLAMORGAN
MONMOUTH
Cardiff
Newport
Llanelly
Swansea
Exeter
Plymouth
Torquay
Tor Bay
Lyme Bay
Bill of Portland
Portland I.
Weymouth
Under Cliffe
Lundy I.
Hartland Pt.
Barnstaple Bay
Bude Bay
Start B.
Start Pt.
Prawle Pt.
Lizard Hd.
Lands End
St. Davids Hd.
Strumble Hd.
Ramsey I.
Milford Haven
St. Govans Hd.
Worms Hd.
Ilfracombe
Bridgewater Bay
Quantock Hills
Leicester
Peterborough
Birmingham
Coventry
Cambridge
Ipswich
Harwich
Colchester
Southend
Mouth of the Thames
Margate
Ramsgate
N. Foreland
S. Foreland
Deal
Dover
Folkestone
Dungeness
Maidstone
Tunbridge
Reading
Guildford
Winchester
Salisbury
Bath
Bristol
Swindon
Longitude 4° West from Greenwich
5°
3°
2°
1°
Meridian of 0° Greenwich
52°
51°
50°
Bormay & Co., N.Y.

town of Carlisle in its centre. The most important of the northern plains is the Vale of York, which has an area of nearly 1,000 square miles. On the west side of the island, in south Lancashire and Cheshire, is the fertile Cheshire plain. In Wales there are no extensive plains, the valleys generally having a narrow, rugged form favorable to romantic beauty, but not compatible with great fertility. Wales, however, by giving rise to the Severn, can justly claim part in the vale, or series of almost unrivaled vales, along which it pursues its romantic course through the counties of Montgomery, Salop, Worcester, and Gloucester. Southeast of the Cotswold Hills is Salisbury plain, a large elevated plateau, of an oval shape, with a thin, chalky soil only suitable for pasture. In the southwest the only vales deserving of notice are those of Taunton in Somerset and Exeter in Devon. A large portion of the southeast may be regarded as a continuous plain, consisting of the Wealds of Sussex, Surrey, and Kent, between the North and South Downs, and containing an area of about 1,000 square miles. The southeast angle of this district is occupied by the Romney marsh, an extensive level tract composed for the most part of a rich marine deposit. Extensive tracts of a similar nature are situated on the eastern coast in Yorkshire and Lincoln, where they are washed by the Humber; and in the counties which either border the Wash, or, like Northampton, Bedford, Huntingdon, and Cambridge, send their drainage into it by the Nen and the Ouse.

For the climate of England see GREAT BRITAIN, *Climate*.

Rivers.— England is well supplied with rivers, many of them of great importance to industry and commerce. Most of them carry their waters to the North Sea. If we consider the drainage as a whole, four principal river basins may be distinguished, those of the Thames, Wash, and Humber belonging to the German Ocean; and the Severn, belonging to the Atlantic. The basin of the Thames has its greatest length from east to west, 130 miles, and its average breadth about 50 miles, area 6,160 square miles. The river itself, which is the chief of English rivers, has a length of 215 miles. The basin of the Wash consists of the subordinate basins of the Great Ouse, Nen, Welland, and Witham, which all empty themselves into that estuary, and has an area computed at 5,850 square miles. The basin of the Severn consists of two distinct portions, that on the right bank, of an irregularly oval shape, and having for its principal tributaries the Teme and the Wye; and that on the left, of which the Upper Avon is the principal tributary stream. The area of the whole basin is 8,580 square miles. The next basin, that of the Humber, the largest of all, consists of the three basins of the Humber proper, the Ouse, and the Trent, and its area is 9,550 square miles, being about one sixth of the whole area of England and Wales. Other rivers unconnected with these systems are the Tyne, Wear, and Tees, in the northeast; the Eden, Ribble, Mersey, and Dee, in the northwest. The southern coast streams are very unimportant except for their estuaries. See THAMES.

Areas and Population.— The total area of England and Wales amounts to 58,323 square miles and the population (1901) aggregated 32,526,075, divided among administrative counties and county boroughs as follows:

ADMINISTRATIVE COUNTIES	Area in Sq. m.	Pop. 1901
Bedfordshire	473.3	171,700
Berkshire	713.3	180,366
Buckinghamshire	749.0	196,844
Cambridgeshire	492.5	120,634
Isle of Ely	371.9	64,494
Chester	1,009.2	601,070
Cornwall	1,356.6	322,960
Cumberland	1,520.4	266,924
Derbyshire	1,010.8	504,577
Devonshire	2,597.8	437,210
Dorset	977.4	202,092
Durham	1,001.1	833,614
Essex	1,523.2	816,503
Gloucestershire	1,236.8	331,516
Herefordshire	842.0	114,150
Hertfordshire	632.0	258,045
Huntingdonshire	365.6	54,127
Kent	1,520.2	936,003
Lancaster	1,707.7	1,827,390
Leicestershire	819.1	225,896
LINCOLNSHIRE		
Lincolnshire—Holland	410.6	77,583
Kesteven	727.9	103,958
Lindsey	1,501.7	206,497
London	117.0	4,536,063
Middlesex	232.3	792,225
Monmouthshire	539.5	230,800
Norfolk	2,036.7	313,438
Northamptonshire	908.9	207,467
Soke of Peterborough	83.5	41,119
Northumberland	2,009.6	388,059
Nottinghamshire	826.8	274,684
Oxfordshire	743.7	137,118
Rutlandshire	152.0	19,708
Shropshire	1,346.6	239,297
Somerset	1,615.8	385,060
Southampton	1,479.1	377,118
Isle of Wight	146.9	82,388
Staffordshire	1,128.2	879,618
SUFFOLK		
Suffolk—Eastern	859.0	189,152
Western	610.8	117,535
Surrey	707.5	519,521
SUSSEX		
Sussex—Eastern	815.3	261,691
Western	630.6	151,541
Warwickshire	879.8	347,691
Westmoreland	789.6	64,411
Wiltshire	1,350.2	271,378
Worcestershire	739.7	358,356
YORKSHIRE		
Yorkshire—East Riding	1,157.9	145,194
North Riding	2,124.5	285,671
West Riding	2,264.2	1,460,861
Total of England	50,216.0	21,931,311
WALES		
Anglesey	276.0	50,590
Brecknock	733.3	54,211
Cardigan	692.3	61,076
Carmarthen	918.4	135,326
Carnarvon	571.8	125,669
Denbigh	665.7	131,588
Flint	254.7	81,490
Glamorgan	792.6	601,092
Merioneth	659.4	48,774
Montgomery	797.0	54,892
Pembroke	613.6	87,910
Radnor	470.6	23,263
Total of Wales	7,446.0	1,455,881
Total of England and Wales.	57,662.0	23,387,192

The county boroughs, that is, self-governing cities with county charters, number 67; these have a total area of 661 square miles, and their combined population in 1901 was 9,138,883.

The returns from the census of 1901 showed an increase in the population of England and

Wales in 10 years of 3,523,191, or 12.15 per cent. The population of the principal cities and towns in England and Wales was as follows: London, 4,536,541; Liverpool, 684,947; Manchester, 543,930; Birmingham, 522,182; Leeds, 428,953; Sheffield, 380,717; Bristol, 328,836; Bradford, 279,809; West Ham, 267,308; Nottingham, 239,753; Kingston-upon-Hull, 240,618; Salford, 221,015; Newcastle-upon-Tyne, 214,861; Leicester, 211,574; Portsmouth, 189,160; Bolton, 168,025; Cardiff, 163,844; Sunderland, 146,828; Oldham, 137,238; Croydon, 133,885; Blackburn, 127,527; Brighton, 123,478; Preston, 120,860; Norwich, 111,728; Birkenhead, 110,906; Gateshead, 109,891; Plymouth, 107,509; Derby, 105,785; Halifax, 104,997; Southampton, 104,500—all others 100,000 or less. See Liverpool; London; Manchester, etc. For history, government, parliament, political parties, judiciary, local government, education, religion, literature, art, army, navy, foreign relations, finance, banks and banking, commerce, industries, agriculture, fisheries, mining, transportation, etc., see Great Britain.

England, Church of, the official name of that body of Christians who have a formal head in the person of the hereditary ruler of England. This designation is used in two senses; first, a general one signifying the Church regarded as continuous, which, from the first triumph of Christianity till now, has been that of the English people; secondly, in a more specific sense, the Protestant Church now established in England as distinguished from the Roman Catholic Church. (See article England, *Early Ecclesiastical History.*) The evangelistic zeal of Whitfield, Wesley, and various other clergymen, in the 18th century, awoke the Church to new life, which did not pass away even when the followers of these two great preachers ceased to belong to the English Church. The evangelical party, still the most numerous in the Establishment, is in large measure, the fruit of 18th century revival effort. In the 19th the movement was in other directions. With 1833, just after the passing of the first Reform Bill, the first of a series of 'Tracts for the Times' came forth, and 90 in all were issued within the next eight years. The ritualistic party, at a later date, carried on the work which the tractarians had begun. In 1860 the 'Essays and Reviews,' and in 1862 a work by Bishop Colenso on the Pentateuch, gave prominence to the opposite pole of thought, being what theologians call strongly rationalistic. Church congresses, bringing the representatives of these three parties face to face, softened their antagonisms, and fear of common danger renders them more united than they otherwise would be. In the English Church, at present, there are 2 archbishops and 29 bishops, both of the former and 24 of the latter having seats in the House of Lords; subordinate to these are 30 deans, 82 archdeacons, 613 rural deans, and about 13,500 beneficed clergy, the whole clerical staff of all grades being about 23,000. Including infants, it is believed to have above 13,000,000 adherents in England and Wales. Previous to 1871, the English Church and the Established Church of Ireland constituted but a single body called the United Church of England and Ireland. It is powerful also in the colonies, and by means of its two great societies, the Propagation and the Church Missionary Societies, acts powerfully on nearly every part of the heathen world.

The 39 articles, as the established confession of the English Church, deserve a short analysis. The first five articles contain a profession of faith in the Trinity; the incarnation of Jesus Christ, his descent to hell, and his resurrection; the divinity of the Holy Ghost. The three following relate to the canon of the Scripture. The 8th article declares a belief in the Apostles', Nicene, and Athanasian creeds. The 9th and following articles contain the doctrine of original sin, of justification by faith alone, of predestination, etc. The 19th, 20th and 21st declare the Church to be the assembly of the faithful; that it can decide nothing except by the Scriptures. The 22d rejects the doctrine of purgatory, indulgences, the adoration of images, and the invocation of saints. The 23d decides that only those lawfully called shall preach or administer the sacraments. The 24th requires the liturgy to be in English. The 25th and 26th declare the sacraments effectual signs of grace (though administered by evil men), by which God excites and confirms our faith. They are two: baptism and the Lord's Supper. Baptism, according to the 27th article, is a sign of regeneration, the seal of our adoption, by which faith is confirmed and grace increased. In the Lord's Supper, according to article 28th, the bread is the communion of the body of Christ, the wine the communion of his blood, but only through faith (article 29th); and the communion must be administered in both kinds (article 30th). The 28th article condemns the doctrine of transubstantiation and the elevation and adoration of the host; the 31st rejects the sacrifice of the mass as blasphemous; the 32d permits the marriage of the clergy; the 33d maintains the efficacy of excommunication. The remaining articles relate to the supremacy of the king, the condemnation of Anabaptists, etc. See Church; Ritual; Trinity, The.

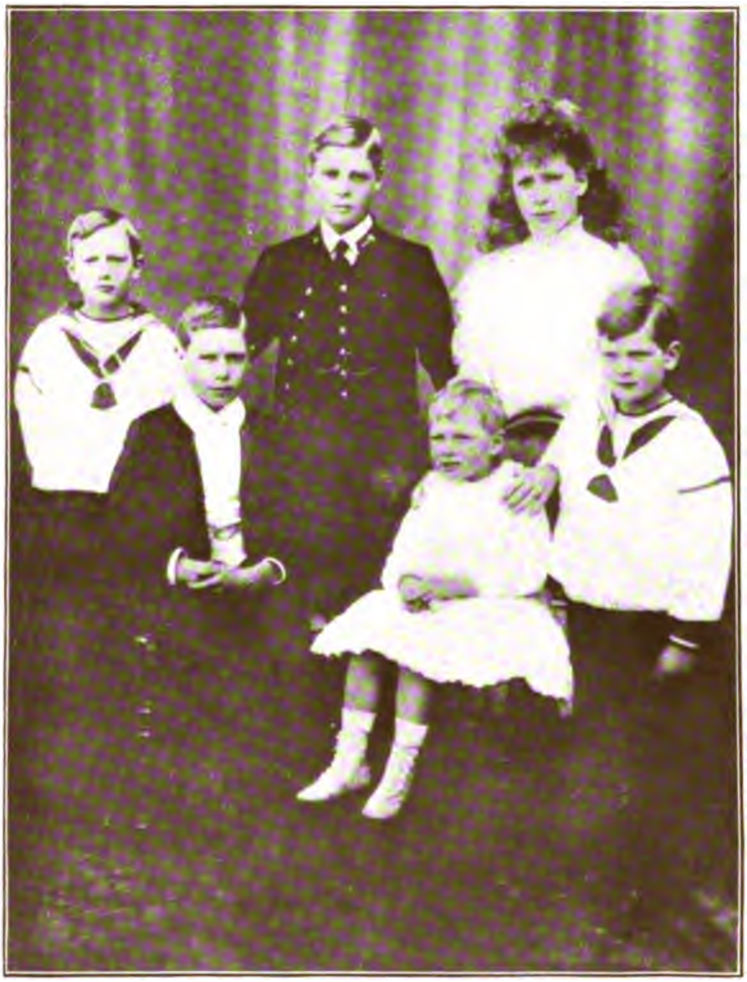
Eng'les, William Morrison, American author: b. Philadelphia 12 Oct. 1797; d. Philadelphia 27 Nov. 1867. He was educated at the University of Pennsylvania and became a missionary among the Indians of Wyoming. Later he was pastor of a Presbyterian church in Philadelphia for several years, and in 1838 he was made editor of the output of the Presbyterian Board of Publication, becoming president of the board in 1863. Among his works are: 'Records of the Presbyterian Church' (1840); 'English Martyrology' (1843); 'Sailor's Companion' (1857), and 'Soldiers' Pocket-Book' (1861).

Eng'lewood, N. J., city, in Bergen County, near the Hudson River, on a branch of the Erie Railway; about 13 miles north of Jersey City. It is a beautiful residential city, contains two summer homes for working girls, a hospital, and a library with nearly 10,000 volumes. Pop. (1910) 9,924.

Englis, John, American ship-builder: b. 1808; d. 1888. He built his first steamers on Lake Erie in 1837. In 1861 he built the Unadilla, the first gunboat built for the United States government. Afterward he built the steamboats St. John, Dean Richmond, Drew, Grand Republic, etc. Many improvements in ship-building were due to him.

English, Earl, American naval officer: b. Crosswicks, N. J., 18 Feb. 1824; d. Washington, D. C., 16 July 1893. He entered the naval service 1840; served in Mexican war; became lieu-

GREAT BRITAIN.



THE PRINCE OF WALES, HEIR-APPARENT TO THE ENGLISH THRONE,

With his brothers and sister.

tenant-commander 1862, and served in the Civil War. He was made commodore 1880, and rear-admiral 1884; and retired 1886.

English, George Bethune, American adventurer: b. Cambridge, Mass., 7 March 1787; d. Washington, D. C., 20 Sept. 1828. He studied law and theology, and in 1813 published 'The Grounds of Christianity Examined,' a work in favor of Judaism. In 1820 he served as an officer of artillery in the army of Ismail Pasha against Sennaar, and was afterward United States agent in the Levant, returning home in 1827. He published a 'Narrative of the Expedition to Dongola and Sennaar.'

English, Thomas Dunn, American author: b. Philadelphia, Pa., 29 June 1819; d. Newark, N. J., 1 April 1902. He was graduated in medicine at the University of Pennsylvania in 1839; admitted to the bar in 1842; engaged in journalism in New York in 1844–59; then resumed medical practice in Newark. He was a member of the State assembly in 1863–4, and of Congress in 1891–5. He was the author of 'Ben Bolt,' an exceedingly popular ballad (1843), which after having long fallen into obscurity was revived by its employment in Du Maurier's novel 'Trilby'; 'Walter Woolfe' (1842); 'Ambrose Fecit, or the Peer and the Painter' (1869); 'American Ballads' (1882); 'Book of Battle Lyrics' (1886); 'Jacob Schuyler's Millions' (1886); 'Old Glory,' song (1898); etc.

English, William Hayden, American capitalist: b. Lexington, Ind., 27 Aug. 1822; d. Indianapolis, Ind., 7 Feb. 1896. He was elected to Congress in 1852 and served there through four consecutive terms. As a member of the Committee on Territories, in opposition to his own party, he worked against the admission of Kansas to the Union. He reported from the Committee of Conference what was known as the "English bill," in which it was urged that the question of admission be referred back to the people of Kansas according to the provision of the Lecompton constitution. This was adopted and the people voted against admission. He strongly opposed secession, and warned Southern Congressmen that the North would never countenance such a policy. In 1880 he was the Democratic nominee for Vice-President on the ticket with Gen. Hancock. He published a historical and biographical work on the Constitution and lawmakers of his State and furnished money to the Indiana Historical Society to complete and issue the 'History of Indiana' which he had begun.

English Art. The history of English art embraces four divisions, that is, Architecture, Engraving, Painting and Sculpture.

Architecture.—Numerous so-called Druidical stones, a few rude towers, and some other mysterious structures, are the only remains of the architecture of the ancient Britons. The only monuments of the Roman occupation of the country are the ruins of military works, such as roads and fortified walls that had been executed on a magnificent scale. Very little can be said with regard to the style that prevailed in England between the invasion of the Anglo-Saxons and the Norman Conquest, from the fact that the remains of buildings erected in England before the Conquest are few and insignificant. There was not a single cathedral built before that date but was rebuilt during the Norman period, or at some later time, and although there are traces in numerous churches of pure Saxon architecture, there is no entire church now standing which was built during the Saxon period. There is thus little known about this style beyond the fact that it was a variety of Gothic, probably rather rude. The Normans introduced a more highly developed kind of Gothic, the style in which most of the English cathedrals are built. The earlier specimens of this style of architecture in England, such as may be seen in parts of the cathedrals of Rochester, Winchester, and Canterbury, naturally exhibit no distinctively English features, but resemble on all points the works executed in the same style on the Continent. It was not till the beginning of the 12th century that the new architecture began to assume a character of its own peculiar to England. Durham Cathedral affords the best illustration of this style. The ogive or pointed arch appears to have been introduced into English architecture in the second half of the 12th century, and the first traces of its use are to be found in the cathedrals of Canterbury, Rochester, and Northampton. This new modification of Gothic architecture soon made way for itself, although it appears to have been adopted with some reluctance in England. In the end it became the prevailing and even the sole style of ecclesiastical architecture in England, the round arch being entirely disused for three centuries. Among the edifices erected in this style between the 12th and 15th centuries may be mentioned the cathedrals of York, Wells, Winchester, Lichfield, Worcester, Chichester, Lincoln, Westminster, etc. The most characteristic peculiarity of Gothic architecture in England, after the introduction of the pointed arch, consists in the form of the windows in which the mullions rise right up to the main arch of the window, and are often crossed by horizontal bars. This peculiarity has caused the name of perpendicular to be given to the style of architecture in which it is found. The Tower of London, Windsor Palace and the great hall of the palace of Edward III. are the finest specimens of military and civil architecture belonging to the same period as the religious edifices above-mentioned. The Renaissance style of architecture made its appearance under the Tudors, and was associated with the Gothic. The palaces of Richmond and Hampton Court, the chapel of Henry VIII., and the tombs of Queen Mary and Queen Elizabeth at Westminster, Bishop West's chapel in the cathedral of Ely, and the six coffins placed by Bishop Fox around the choir of the cathedral of Winchester, are the principal examples of this mixed style, in which are wanting both the elegance in details and the capricious fancy which distinguish the productions of continental art during the same epoch. In the reign of Charles I. Inigo Jones designed, among other buildings, St. Paul's at Covent Garden and Greenwich Hospital in a peculiar style, imitating the Græco-Roman. Architecture, neglected under the Commonwealth, revived after the Restoration, when Sir Christopher Wren designed an immense number of buildings, particularly St. Paul's Cathedral at London, the towers of Westminster, the Sheldonian theatre of Oxford, Chelsea Hospital, etc. Other architects of his time were not less productive. Among them are Gibbs, and Sir John Vanbrugh. In the 18th century the style of Louis XV. prevailed in England. The most celebrated architects of the time were W. Chambers and Robert Taylor. At the present day English architects are in the habit of copying indifferently from all styles, and sometimes even mix up different styles in the most monstrous fashion. The most striking novelty in architecture in the 19th century is the method of building in glass and iron, first resorted to on an extensive scale by Sir Joseph Paxton in the International Exhibition of 1851, and subsequently adopted in the Crystal Palace and various other structures. See ARCHITECTURE.

Engraving.—Until the 18th century engraving was not cultivated at all in Great Britain except by foreign artists. The German engraver, Wenzel Hollar (d. 1677), was the most distinguished engraver in England in the 17th century. Alongside of the national school of painters, created in the 18th century by Hogarth, Gainsborough, and Reynolds, there arose almost simultaneously an English school of engravers. Hogarth himself acquired some distinction in the art of engraving; but those who were more specially devoted to this branch of art were George Vertue (1684–1756, celebrated especially for portraits), Sir Robert Strange—a Scot (1721–92), Valentine Green (1739–1813), and Richard Earlom (1743-1822). The last two were mezzotint engravers, and carried this branch of the art to a high degree of excellence. The most celebrated line-engravers in the period immediately subsequent to that during which those just mentioned lived were William Sharp (1749–1824), James and Charles Heath (the former died 1834, the latter 1848), and James Fittler (1756–1835). At this period many small plates were produced as illustrations for books. Toward the end of the 18th century the stipple style of engraving was introduced by the Italian Bartolozzi, and since that period it has been followed by a good many English engravers. In 1775 Thomas Bewick (1753–1828) revived engraving on wood, a style which has since been very extensively resorted to for the illustration of periodicals and other works. The most distinguished of his followers were his pupil Clennell, Branston, and John Thompson. Among other English engravers on copper or steel we may enumerate George Doo, John Burnet of Scotland, Samuel Cousins, William Holl, Edward Goodall, and John H. Robinson. In steel engraving English artists have manifested a decided superiority over those of other countries. In lithography, too, some of the English artists have displayed genuine talent. Among the best works which have appeared in this department may be mentioned the collections of architectural views of England and Belgium by Haghe and Nash. See ENGRAVING.

Painting.—Very little is known of the state of the art of painting among the Anglo-Saxons. In the 7th century, Biscop, abbot of Wearmouth, brought from Italy a large number of pictures with which he adorned the churches dependent upon his monastery. In the 9th century Alfred the Great, with the view of refining his war-like subjects, caused numerous manuscripts to be made and adorned with miniatures. Toward the end of the 10th century, Dunstan, archbishop of Canterbury, had the reputation of being an expert miniature painter, and some of his illuminations are preserved in the Bodleian Library at Oxford. Under the reign of William the Conqueror, and those of his two sons, the painting of large pictures began to be studied. Lanfranc, archbishop of Canterbury, a native of Lombardy, one of the most renowned men of letters of his time, adorned the vault of his church with paintings of ravishing beauty, to use the expression of a chronicle of the period. Numerous miniatures of the 13th and 14th centuries have come down to us; the execution is rude, but the style does not want originality. From this period down to the 18th century there were few native painters, and scarcely any of importance in England. A succession of foreign painters were attracted to the country by the munificence of some of the English sovereigns, and of the English aristocracy, but no native talent was developed in this direction. Among these foreign painters connected with England may be mentioned Hans Holbein, a German painter, who enjoyed the favor of Henry VIII.; Federigo Zuccaro, an Italian, who came to England in the reign of Queen Elizabeth, and painted at her court; and Sir Anthony VanDyck, the great Flemish portrait-painter, who lived at the court of Charles I. There is one native English painter deserving of mention who appeared before the close of the 17th century, although even his chief works belong to the 18th. This was Sir James Thornhill (1676–1734), the painter of the cupola of St. Paul's in London, and of the Painted Hall in Greenwich Hospital. The period of the decline of the art on the Continent was the time when England attained her highest eminence in it. When there was no longer any art in Italy, Spain, Germany, Flanders, and Holland, and when France alone of continental countries possessed some painters of lively fancy, there suddenly appeared in London a painter of original and consummate genius, who may almost be said to have created a new kind of painting, in which the artist exhibited the qualities of a moralist and satirist combined with those of the painter; and he was closely followed by two portrait-painters, whose portraits rivaled, in point of elegance, those of VanDyck. The first of these was William Hogarth (1697–1764); the two latter, Sir Joshua Reynolds (1723–92), and Thomas Gainsborough (1727–88). Gainsborough was a distinguished landscape- as well as a portrait-painter. Throughout the 18th century portrait-painting was the most brilliant specialty of the English school. At the same time that Reynolds and Gainsborough flourished there lived also George Romney (1734–1802), who almost equaled them in excellence, and a little later Sir Henry Raeburn (1756–1823), a painter endowed with some share of the vigor of Velasquez, and Sir Thomas Lawrence (1769–1830), who attained more nearly than any other painter to the elegance of style of Sir Joshua Reynolds. He succeeded Sir Joshua in 1792 as court-painter. Barry, Opie, and Copley, the last an American, are among those who manifested more talent in the painting of simple portraits than in the historical composition which they attempted. There also flourished during this century Richard Wilson (1713 or 1714–82), a Welsh landscape-painter in the style of Claude and Poussin, and Benjamin West (1738–1820), an historical painter, who, though American by birth, deserves to be mentioned here from the fact of his having come early to England, and having been connected with England during the most of his life. Hogarth had no immediate successor in the painting of familiar scenes of daily life. This kind of painting was revived with great effect at the beginning of the 19th century by Sir David Wilkie (1785-1841), one of the most popular and highly esteemed of British artists, He made his first appearance at the Academy Exhibition of 1806 with his 'Village Politicians.' Among the painters who have followed in the footsteps of Wilkie may be mentioned William Mulready (1786-1863), Charles Robert Leslie (1794-1859); Daniel Maclise (1811-70); John Phillip (1817-67); William Powell Frith (b. 1819); Thomas Faed (1826-1900); William Holman Hunt (b. 1827); and Sir John Everett Millais (1829-96). The last two were among the founders of the pre-Raphaelite school of painters, the distinguishing characteristic of which is extreme fidelity in matters of detail. The chief historical painters of the 19th century include William Etty (1787-1849), and Benjamin Robert Haydon (1786-1846); by far the most celebrated landscape painter is Joseph Mallord William Turner (1775-1851); and Sir Edwin Landseer (1803-73) is the most distinguished animal-painter that Great Britain ever produced. Water-color painters have been very numerous and successful in England; among them are Corbould, Cattermole, Haghe, Wehnert, Prout and Gilbert (also an oil-painter). See Art; Hogarth; Painting; etc.

Sculpture.—Cæsar records that the ancient Britons were fond of cutting out ornaments of various kinds on their chariots of war, but that they were entirely ignorant of the art of casting statues in metal, or cutting them in stone. The ivory drinking-horn of Ulfus, preserved at York, is one of the few specimens of carving that has come down to us from the time of the Anglo-Saxons. After the Norman Conquest the arts of carving and sculpturing were practised almost wholly by foreign artists, Frenchmen and Italians, and it was not till the 13th century that some remarkable works began to be produced by native artists. At this epoch, however, the arts of carving and sculpture were still regarded merely as handmaids to architecture. These arts received a check during the wars of the Roses, and were not again cultivated till the Renaissance period, when Torregiano came from Italy and executed two masterpieces in England, the tomb of the mother of Henry VII., and that of Henry himself, at Westminster. The troubles of the reign of Charles I. and the Commonwealth produced a new stagnation in the art; and what is more to be regretted, were the cause of the destruction of many valuable works of art in this department. After the Restoration two sculptors of some note appeared in England, Grinling Gibbons, a wood-carver, born at Rotterdam, and Caius Gabriel Cibber, who, though ridiculed by Pope, was a man of real talent. During the 18th century there was no English sculptor of eminence till John Flaxman (1755-1826) appeared to resist the false taste of the time. His monument to Lord Mansfield, and his statues to Pitt and Reynolds, are among the finest productions of English sculpture. He had for rival and successor Sir Francis Chantrey (1781-1841), who acquired renown by the statues which he made of most of the eminent men of his time. John Carew, Lawrence Macdonald, Sir Richard Westmacott (1775-1856), Edward Hodges Bailey (1788-1867), and John Gibson (1790-1866), are a few of the sculptors of the earlier half of the 19th century, to whom we should not forget to add J. H. Foley, W. C. Marshall, P. McDowell, Sir John Steell, and H. Weekes, as among the first sculptors of their time. See Sculpture.

English Channel, or The Channel (Rom. *Oceanus Britannicus*), an arm of the Atlantic Ocean extending into the west coast of Europe to the Strait of Dover, by which it is connected with the North Sea. The land bodies separated by this channel are England and France. Its length from the Strait of Dover to the Atlantic Ocean is 280 miles; its greatest breadth, from Saint Malo, in France, to Sidmouth, in England, is 140 miles; area 30,000 square miles. The length of the north coastal line, from Land's End to Dover, is 390 miles; and of the south coastal line is 570 miles. Some of the largest indentations on the coast of England are the bays of Falmouth, Plymouth, Lyme, Weymouth and The Solent. On the coast of France are Baie de la Seine and Baie de Mont St. Michel. The principal islands in the Channel are: Isle of Wight, Channel Islands, and several other islands near the coast of France; Scilly Isles and Ushant at the entrance.

English Chronicles. The writing of English chronicles begins with the 'Anglo-Saxon Chronicle,' the earliest English history written in the English language, and the earliest vernacular record of national events in modern Europe. The 'Chronicle' opens with the Christian era, combining in its earlier parts records of Roman, Christian, and British events. It rapidly becomes strictly national, carrying the record of English history forward to a considerable period after the Norman Conquest. It treats in general of the affairs of all the English-speaking peoples in Great Britain, and as one of the first attempts at an expression of coherent national life and as a trustworthy source of information concerning the language, history, and social manners and customs of the Anglo-Saxon period, the importance of the 'Chronicle' can hardly be over-estimated. Although the work itself does not mention the name of its author, there is strong evidence to show that in its original form it was undertaken at the suggestion of King Alfred and was in part actually written by him. From this original form, now no longer extant, copies were made and carried to different sections of England, where they served as foundations of what, from that time, became separate and independent chronicles. Seven of these local chronicles, with a fragment of an eighth, have come down to us. The date at which the original parent version was made was about 892, and the place was probably Winchester, the capital of the West-Saxon kingdom. The form in which the 'Chronicle' is written is that of a book of annals, the entry for each year containing usually the record of but a single occurrence. For the early years the records, derived chiefly from literary sources, are brief and colorless, but in the later parts, particularly in the accounts of the Danish wars, when the narrative becomes more nearly contemporary with the time of the compilation of the work, they become more detailed and vigorous. At no time, however, is there an attempt to write a philosophic history, to point out the causes or the trend of events. This is in accord with the main purpose of chronicle writing, which is merely to keep the events of history in their right chronological perspective, the details centering about these events being largely entrusted to oral tradition. This annalistic purpose of the 'Chronicle' determined also its mechanical form. The scribe's method was to rule off a number of pages as though preparing a journal in which the entries were to be made by years instead of days. Each year was thus given a blank space opposite its number sufficient usually for only a few lines. The scribe then inserted whatever annals he had been able to collect, leaving the spaces for which he had no materials to be filled in later when new material should become available. This method of chronicle writing remained long in use in England, being followed by Capgrave as late as the 15th century.

Although no single model or source for the 'Chronicle' is known, there were in existence in Alfred's time a number of Latin works which were of help on its original compilation. Of these the most important were Bede's 'Historia Ecclesiastica Gentis Anglorum,' finished in 731; Bede's 'De temporum ratione,' a chronological essay containing a short epitome of the history of the world from Adam to 729 A.D.; Orosius' 'Universal History' ('Pauli Orosii Historiarum Adversum Paganos Libri VII.'); and doubtless many records of national events preserved in local monastic libraries. But the 'Chronicle' was an original work in that it strove to record the life of a nation. Just as the codes of laws systematized the customs and rules of living of the people, so the 'Chronicle' fixed for them the ever-receding events of this history.

From the period of its original composition to the middle of the 11th century, the 'Anglo-Saxon Chronicle' established the form for all historical writing in England. Although we now know only seven, with the fragmentary eighth, versions of the 'Chronicle,' the number in the Anglo-Saxon period must have been much greater, copies being probably kept at every important monastery and town. Towards the end of the Anglo-Saxon period, however, the 'Chronicle' tends to become less and less national, and more and more ecclesiastical in its character. In harmony with this change, the language of chronicle writing changed also to Latin. The use of Anglo-Saxon as late as 1154, the date of the latest entry in that tongue, appears only in one version, and is plainly due to reasons of respect for the traditional language of the 'Chronicle.' To take the place of the English annals of the 'Chronicle,' new histories began to be written in Latin. The earliest of these was that of Ethelwerd; others from the beginning of the 12th to the 14th century were the histories of Symeon of Durham, Florence of Worcester, William of Malmesbury, Henry of Huntingdon, Roger of Hoveden, Matthew of Paris, Matthew of Westminster, Roger of Wendover, and Ralph Higden, whose 'Polychronicon' was the "standard work of general history in the 14th and 15th centuries" (Babington, ed. of 'Higden' in 'Roll's Series,' p. xliii.). All of these Latin histories derived much of their material either directly or indirectly from the Anglo-Saxon Chronicle. In the Middle English period, several metrical histories were written in English, the 'Brut' of Layamon, the chronicles of Robert of Gloucester, and of Robert Manning of Brunne; but these are better characterized as historical romances than as attempts at veracious history. The writing of prose histories in English begins again with Trevisa's translation of Higden's 'Polychronicon,' made in 1387, and with John Capgrave's original chronicle, written about the middle of the following century. The tone of Capgrave's work, as compared with the Anglo-Saxon Chronicle, is extremely naïve. The writers of the Chronicle had a most rigid sense of historical fact, but the work of Capgrave and his contemporaries is marked by an altogether uncritical and credulous mingling of legend and history. As a result, however, of this infusion of the romantic spirit into historical writing, the older annalistic method gave way to one in which greater attention was paid to a consecutive narrative interest, after the manner of modern historical writing. The national awakening accompanying the reigns of Henry VIII. and Elizabeth resulted in a renewed interest in the writing of these history-chronicles. In 1516 appeared Fabyan's 'New Chronicles of England and France'; in 1562 Grafton's 'Abridgment of the Chronicles of England'; in 1565 Stowe's 'Summarie of Englyshe Chronicles'; and in 1578, the most important of the Elizabethan chronicles because of the use made of it by Shakespeare, 'The Chronicles of England, Scotland, and Ireland,' written by Holinshed with the assistance of several others. The term chronicle continued to be used in the titles of historical works to the end of the 17th century, as in Sir Roger de Coverley's favorite book, Baker's 'Chronicle of the Kings of England,' 1643; by this time, however, the naïve annalistic chronicle had largely given way to the more philosophical treatment of events which is designated by the name of history.

Bibliography.—For general bibliography, consult Gross, 'Sources and Literature of English History from the Earliest Times to about 1485' (1900). Editions of most of the chronicles will be found in the Great Britain Rolls Series; the best edition of the Anglo-Saxon Chronicle is that of Earle and Plummer (Oxford 1892-1899). The literary significance of the chronicles is discussed by Schofield, 'English Literature from the Norman Conquest to Chaucer' (pp. 29-46); and by Schelling, 'English Chronicle Plays' (New York 1902).

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English College at Rome, an ancient institute in the papal city, founded, according to mediæval chroniclers, about 816, for in that year the *angelcynes scolu*, school of the English nation, was destroyed by fire. Built anew, it had a like fate twice in that century. Thomas à Becket, archbishop of Canterbury, was lodged in the hostel when he visited Rome. Shortly after the murder of the archbishop and his canonization the church adjoining the college was called by his name. Later the hostel connected with the college was abandoned, and in 1380 a new hostel was built and liberally endowed, chiefly by rich London merchants, for free entertainment of Englishmen visiting the Holy See. In the time of Henry VIII. refugees from England were harbored in the hostel. In the reign of Elizabeth the institution was transformed into a seminary for the education of aspirants to the priesthood who proposed to serve in the English mission, which they entered with pretty fair assurance of the martyr's crown. Between 1578 and 1647, 40 of the alumni of the institution, serving as missionary priests in England, were executed for the high treason of exercising the Catholic ministry contrary to the laws of the realm; and when St. Philip Neri, founder of the Congregation of the Oratorians, met any of the young English ecclesiastics in the streets of Rome, his invariable salutation was *Avete flores martyrum* — "Hail flower of the martyrs." The college was plundered and wrecked by the French republican army 1798 and its resources dissipated; it was resuscitated 1818; its president from 1831 to 1846 was Nicholas Wiseman, afterward first archbishop of Westminster, and cardinal.

English Constitution. See ENGLISH POLITICAL DEVELOPMENT; PARLIAMENT.

English Harbor, a harbor on the southern coast of Antigua, one of the Leeward Islands. It is the site of a British naval station, which from its location is one of the important British possessions of the West Indies.

English Language. The English language is a direct development of the Anglo-Saxon, a circumstance which makes it questionable whether the latter speech ought to be distinguished by a separate name. But although a direct development of the Anglo-Saxon, it is not a development which has been allowed to take place regularly and gradually, as the result merely of internal causes. One important external influence was brought to bear on the original form of our language, which had the double effect, first, of producing a much more sudden and complete modification of the grammatical structure than could have taken place if the language had grown up independently of foreign influences; and secondly, of giving a composite character to the vocabulary of the language by the introduction of a large number of foreign words. This external influence was the Norman Conquest, in consequence of which a new language, the Norman-French, came to be spoken in England by those who had made themselves the masters of the country, and who formed, therefore, almost the only class that had leisure and opportunity for literary pursuits. The immediate result of the Norman Conquest (1066) was thus that the language of the Normans came to be the chief literary language of England (except where Latin was used), and that the Anglo-Saxon was reduced to a very subordinate place. When the latter language again comes into notice as a written language, a great change is seen to have been wrought in it. Before the Conquest it was a very highly inflected, or what is called a synthetic language, that is, one in which the substantives, adjectives, verbs, and articles are subject to numerous modifications, each of which expresses a modification of the root-meaning of the word, or shows the relation of the word to the other words in the sentence. During the period when Anglo-Saxon ceased to a great extent to be a written language these inflections dropped off; and when it re-emerges as a written language about the end of the 12th century, it is no longer synthetic, but analytic, that is, prepositions and auxiliaries are now used instead of inflectional prefixes and terminations to express the various modifications of the idea contained in any word, and the relations of the words in a sentence to one another. At this period, however, the language still continued to be essentially homogeneous in respect of its vocabulary: the Norman words that occur are so rare that they need not be taken into account. And it was natural that it should be so, for the Saxon language was still confined to the Saxon inhabitants of the country; and those who wrote in it addressed themselves only to that portion of the community, and accordingly had no occasion to use any word of Norman origin. This state of matters lasted till about the middle of the 13th century, which is the period at which English proper is usually regarded as having begun to be spoken and written. By this time the Normans began to experience the inconvenience of not being acquainted with the language of the people among whom they dwelt, and in learning to speak and write it they very naturally used a large number of Norman words, and these words were adopted by all such writers belonging to the subject race as wished to make themselves understood by Norman as well as by Saxon readers. A very rapid mixing of the two languages thus took place, and a second important change was wrought in the English language. It is no longer homogeneous in its vocabulary, but contains a large admixture of foreign words. The whole of what precedes may be shortly summarized thus: — From 450 to 1066 the language spoken in England was the so-called Anglo-Saxon, a dialect of Low German, very highly inflected. From 1066 to 1250 two languages were spoken in England, Anglo-Saxon and Norman-French, by two different sections of the population occupying different political positions. During this period the grammatical structure of the former language began to be broken up, chiefly owing to its being disused for literary purposes; and toward the end of the period we find a few works written in a language resembling the English of our day in grammar, but differing from it by the homogeneousness of its vocabulary. Finally, about 1250 the two languages begin to mingle, and form one intelligible to the whole population, Normans as well as Saxons. This is what is usually called English proper. English is thus seen to be a composite language, deriving part of its stock of words from a German source, and part from a Latin source, Norman-French being in the main merely a modified form of Latin. The changes that have taken place in the English language subsequently to 1250 are by no means as striking as those which took place in the transitional period between 1066 and 1250. Some few inflections which the English of the 13th and 14th centuries still retained have now been dropped, but the chief change which the language has experienced consists in its gradual growth and expansion in obedience to the requirements of advancing science, more complicated social relations, and increased subtlety of thought. This growth has been going on at all times, but there are some periods which may be pointed out as more remarkable than others for the rapidity with which it proceeded. Such a period was the end of the 16th and the beginning of the 17th century, the period of the Reformation and following the revival of learning, when numerous words of Latin origin were introduced by scholars directly from that language, instead of through the French, the channel through which most of the Latin words previously found in the language had come. Another such period is the present, when the rapid growth of the sciences already existing, and the creation of new sciences, have caused whole groups of words to be introduced, chiefly from the Greek.

It would scarcely be in place here to discuss the various excellencies and defects of the English as compared with other languages, but we may mention the following as among the qualities which the English language is generally allowed to possess. 1. Strength and expressiveness, adapting it admirably for poetical composition. 2. Copiousness. In connection with this may be noted the extraordinary receptivity of the language, that is, its capacity for adopting new words from all sources, and of naturalizing them at once, so that they may be treated without any appearance of strangeness entirely as native English words. 3. Simplicity in form and construction. 4. Great flexibility, or adaptability to all kinds of composition, the grave and gay, the impassioned and calm, forcible and tender, sublime and ludicrous.

In connection with the subject of the English language, we may here further observe, that England and the United States offer the first instance in history of two great, independent, and active nations having a common language, but situated at a great distance from each other, and daily developing new and characteristic features. These relations must, sooner or later, exert a powerful influence upon the common language, for no language is so stable as not to undergo continual changes, if spoken by a people in the full vigor of social and political life. This state of things has already produced some effect on the English language. The most material difference, probably, has been in the pronunciation of the language, which, however, important in our daily conversation, is of secondary importance in relation to the literature and written language of the two countries. It has often been observed by English travelers and others that the pronunciation of the United States is far more uniform than that of England; and so nearly alike everywhere, that the people of any one town or district are perfectly understood in every other part of the country, which is not true of the lower ranks of England. When considered more minutely, however, there has for a long time existed a marked distinction between the pronunciation of the New England and Southern States. The orthography of the English language has undergone no material change in America, it being the general inclination to follow that of the best English writers of the age.

The English language may be divided into five periods:

1. First Period 450-1100 A.D.
2. Second Period 1100-1250 A.D.
3. Third Period 1250-1350 A.D.
4. Fourth Period 1350-1460 A.D.
5. Fifth Period 1460 A.D.—the present day.

In the first period (called also Anglo-Saxon or Old English), the language was inflectional; in the second it began to show a tendency to become analytic, the tendency increasing till in the fourth period inflections had virtually disappeared. Before the Norman Conquest there were two dialects in English, a southern and a northern, the former of which was the literary language. After the Conquest dialects became much more marked, so that we can distinguish three great varieties, the northern, the midland, and the southern, distinguished from each other by various grammatical differences. The midland dialect was that most widely spread, and it ultimately became the standard language, a result principally due to the influence of Chaucer, and in a less degree of Wyclif, Gower, and others. See DIALECT; SCIENCE OF LANGUAGE.

English Literature. The Norman conquest made a great change in the development of an English literature, as in all other departments of English life. Conditions were at first most unfavorable: the English language might be used by any who pleased, but the clergy naturally used Latin, and people of any position, French, or Anglo-Norman, as it is commonly called. For three centuries, therefore, we do not find in English any striking original work, anything to compare in interest with the Skaldic poetry and the Sagas in Iceland, with the French romances and fabliaux, with the German epic and courtly poetry. During these centuries, however, we do find in England what is in its way most interesting, namely, a singularly rich representation of the different phases of mediæval thought. We may conveniently begin with the work connected with the older order of things. The Anglo-Saxon Chronicle was still kept up at Worcester and at Peterborough. Of these the former is preserved only as far as 1079; the latter is a much later work; in 1121 the whole chronicle was rewritten and then carried on to 1154, being something more than a mere set of annals, with a distinct character of its own. After this, beginning indeed before, comes a stately series of Latin chronicles, but in English we find only chronicles in verse. Layamon's 'Brut,' (c. 1200, after the Anglo-Norman of Wace, which itself is a paraphrase of Geoffrey of Monmouth) is most interesting as language, literature, and legend, giving, among other things, the introduction of King Arthur to English readers. Much later are the chronicles of Robert of Gloucester (c. 1300) and Robert of Brunne (1330). Layamon is hardly as much history as romance. Of this latter almost everything is from French, Scandinavian or Celtic sources: there is little native English either in form or substance. 'King Horn' (c. 1250) and 'Havelock the Dane' (c. 1275) probably go back to Scandinavian originals, though they are still regarded by some as English legend material: more purely national are the stories of 'Bevis of Hampton' (c. 1275) and of 'Guy of Warwick' (c. 1300), though the versions preserved are probably from Anglo-Norman originals. Renderings of Continental romances are numberless, beginning about 1250 with the Alexander story and going on with the tale of Troy, the stories of King Arthur, the Round Table, and the Holy Grail, where the material is partly Celtic, giving even somewhat of the legends of Charlemagne, and many minor stories, as 'Floris and Blancheflor,' 'Amis and Amilon,' 'Sir Tristram.' Somewhat later (1300), and less fully, come versions of the fabliau, 'Dame Siriz,' 'Reynard the Fox,' the 'Land of Cokayne,' the 'Lay of the Ash.' About this time appear the great mediæval collections of stories, the 'Seven Sages' and the 'Gesta Romanorum,' which latter, though in Latin, was collected in England. Besides all this epic and narrative material there is a smaller lyric element: oftenest anonymous, like 'Sumer is ycumen in,' (c. 1250), 'Winter wakeneth all my care,' and other love songs, as well as many political songs, among which are the patriotic poems of Lawrence Minot (c. 1325). But generally where it is not narrative, the Middle English poetry is didactic: the so-called Proverbs of Alfred, dating from the twelfth century and preserved in several versions, may have old material and certainly keep something of the old alliterative form, though there is also the Norman element of verse. And as the Anglo-Saxon priestly writers used alliteration in their didactic prose, so now much of the religious literature is put into rhyme, a fashion of the Norman. The 'Poema Morale' (1200) is a sermon in verse, though now and then with a personal element, and there are many more shorter homilies. A common form is the dialogue; the 'Debate of the Body and the Soul' is known in various forms (1200 and after), the dialogue between 'Mary and the Cross,' and others including, in lighter mood from a French source, the 'Owl and the Nightingale' (1220), a poem full of popular wisdom in which the gay and the gloomy views of life are championed respectively by the two birds who refer the dispute to Master Nicholas of Guilford, generally taken as the author. Less original in substance are the versions of Scripture of which the 'Ormulum,' a metrical paraphrase of the Gospels by Orm of Lincolnshire (1220) is most important for linguistic reasons, preserved in an autograph copy (probably) with an individual system of phonetic spelling. Versions of Genesis and Exodus (c. 1225) are also to be mentioned, while much later in the north (1320) 'Cursor Mundi' reviews the whole extent of history from the creation to the day of judgment. Lives of the saints there were also, especially of Saints Katherine, Margaret, and Juliana, and much devotional poetry, some lyric, like the 'Wohung of oure Loverde' (c. 1225), and others, some didactic, like 'Hali Meidenheid' (c. 1250). There are also certain larger religious treatises: the 'Ancien Riwle' (1225), a prose work of considerable merit, giving the conditions of convent rule, and in the early part of the fourteenth century, three books on holy living, the 'Prick of Conscience,' by Richard Rolle of Hampole; the 'Ayenbite of Inwit,' by Dan Michael of Northgate, and 'Handlyng Synne,' by Robert of Brunne, the two latter from the French. Also to be noted is the very characteristic 'Bestiary' (1225), a compilation of the mediæval speculation on natural history. Such are the main elements of Middle English literature before 1350, although the number of particular works is far greater. As is common in mediæval literature the language is dialectic: no one dialect gains entire primacy till much later, although by this time the East Midland has become the most important. The second half of the fourteenth century was a period of great literary activity. England had been long separate from Normandy, and the English language, like the English people, had digested its different elements into an organic combination. Literature now becomes more literary. The old forms were now only to some degree preserved: Trevisa translated the 'Polychronicon' of Higden (c. 1387); Barbour in the north wrote a rhymed chronicle of Bruce (c. 1375). There are numbers of romances from the French. But didactic or allegoric poetry appears in forms which, though not new, have yet a certain original character. There are two great poets: one of name unknown, the author of the 'Pearl,' 'Gawain and the Green Knight,' 'Cleanness,' and 'Patience,' the other William Langland (as is most commonly thought), the author of the 'Vision Concerning Piers the Ploughman.' Fine as is their work, it is outshone by the genius of Chaucer, who gathered up and summarized the spirit of the century and whose influence was carried through the century following by companions or followers of whom the most noteworthy were Gower, Hoccleve, and Lydgate. The epoch was also illuminated by Wiclif's great translation of the Bible (c. 1382). Two more popular forms of literature must be mentioned, as beginning lines of literary development still important. The ballads of Robin Hood probably go back to this period, while many of the Scotch ballads are older. The four cycles of mystery plays, those of Coventry, Chester, Wakefield (Towneley plays) and York, belong to the earlier part of the century. One remarkable book comes in no category, the 'Voiage and Travaile of Sir John Mandeville,' widely spread in England, and, though a translation, a monument of noteworthy prose. The 15th century was a period of bloody civil strife, and in literature a period of great dearth. Little can be mentioned in a summary. Sir Thomas Malory closed the period of the romances of chivalry by the 'Mort Darthur' (c. 1475), a collection to which he gave organic form and unity. The book was first printed (1585) at the press of Caxton, himself a writer and compiler. Some prose treatises are noteworthy, in religion Pecocke's 'Repressour of too much overblaming of the Clergy' (c. 1450); in politics, Fortescue's 'Monarchy,' (c. 1425), while of lighter interest is the treatise on 'Hawking' by Dame Juliana Berners (c. 1425), and the every-day Paston Letters which belong to literature because they are so interesting.

With the 16th century new influences become powerful. The revival of classic learning stimulated English scholars under the leadership of Grocyn, Linacre, Colet, Cheke. The ideas of the reformation stirred up clouds of controversy in which appear the great figures of Tyndale, Latimer, Coverdale. The spirit of nationality was aroused and More ('Utopia,' 1515), and Elyot (Governour, 1531), thought deeply on questions of politics. These men wrote not so much for literary reasons as for some particular purpose: later came the impulse of the Renaissance which brought forth in England a wonderful burst of literature, generally included in the age of Elizabeth. Most important was its manifestation in the drama. To the mystery plays had succeeded miracle plays, and then moral interludes, and imitations and translations from Seneca and Terence. By the latter half of the century appeared the first specimens of modern drama, 'Ralph Roister Doister,' by Nicholas Udall (1550) and 'Gorbuduc,' later called 'Ferrex and Porrex,' by Sackville and Norton (1569). The Theatre was built in 1579, the Curtain not long afterward, and in the last decade of the century the Rose, the Globe, the Fortune and others. The theatre of the day demanded a drama rich in poetry, rhetoric, declamation, and action. The first group of dramatists, Lyly, Peele, Kyd, Greene, and greatest of them, Marlowe, were all of necessity experimentalists. They created the romantic drama, with tragedy, comedy, history, into which Shakespeare poured his inexhaustible stores of imagination, observation, and wisdom. His plays are typical of the Elizabethan drama: there is little in the other dramatists that you cannot find in him. Yet there were others of great power. Ben Jonson is usually accorded second place, and Beaumont and Fletcher, Marston, Middleton, Heywood, Chapman, Massinger, Ford and Shirley, beside others, have each special powers, although a decline occurs and in 1642 the theatres were closed by order of Parliament and a great dramatic tradition came to an end. One later form deserves special mention: the masque was originally a form of private theatrical and always remained distinct from the plays presented at the public theatres. It was produced for some special great occasion and employed all the possibilities of the day in scenery and costume, music and dancing. The words were often written by dramatists of great ability, notably by Ben Jonson. The most famous and beautiful masque was written at the end of the period, the 'Comus' of John Milton. In lyric poetry as well as in dramatic was the age pre-eminent. In the reign of Henry VIII., Wyatt and Surrey had led the way, though under the influence of Italy, in 1557 appeared Tottel's 'Miscellany,' an anthology which gathered up the verse of preceding years, and some years afterward came another, the 'Paradise of Dainty Delights.' Later collections are the 'Bower of Delights,' 1591; 'The Phœnix' Nest,' 1593; 'The Passionate Pilgrim,' 1599; 'England's Helicon,' 1600. Another characteristic production was the sonnet-sequence, of which Sidney's 'Astrophel and Stella' (1591, but written before), is one of the best and earliest examples. Here belong the famous sonnets of Shakespeare, as well as Daniel's 'Delia' (1592), Drayton's 'Idea' (1593), Spenser's 'Amoretti' (1595), among a host of others. One great lyric poet is pre-eminent, John Donne, whose poems, written in his earlier years, had immense influence. This form of the lyric is in the imitations fanciful and finespun, but in Donne himself it is alive and wonderful. Last among the lyrics and as important as anything else are the songs. Music had an important place in English life, and where there was so much singing, there needed to be good songs. There appeared great numbers, some in the plays and others in song-books, of which many still exist. A good many are translations and more are very slight, but Shakespeare's and Jonson's among the dramatists, and Campion's among the song-writers, are worthy a high place in any anthology. In the seventeenth century, while the drama lost power, the lyric sustained itself remarkably, though in the hands of fewer artists. They are generally followers in well-known lines, the paths of Spenser, of Jonson, of Donne, but they often produced work quite equal to their masters. The early poems of Milton, the exquisite 'Hesperides' (1647) of Herrick, the courtly and amatory poetry of Carew, Suckling, Lovelace, the religious poetry, passionate and almost sensuous in Crashaw, earnest and devoted in Herbert, these show no failure in power or in genius. One great name in Elizabethan poetry is still to be mentioned, that of Spenser. The 'Amoretti' are as beautiful as any of the sonnet cycles, the 'Shepherd's Calendar' (1579) was an immense influence for a long time, but his great title to fame is the 'Faerie Queene' (1590–96), a work which in literary form stands a little apart from its time. It is a romantic epic, akin to the Italian poetry of the preceding century, but Spenser's own, in its high idealism, its pictorial quality, and its mastery of poetic expression. It had imitations and followers, but none of great merit. It is well-nigh impossible to bring the prose of this period under any series of heads. Poetry always comes first in literary development: in the 16th century prose was commonly written for some practical purpose. It is true there was some growth of style: many men labored at improving the vocabulary and elaborating the sentence-structure and the resources in figure and ornament. Yet there were hardly any well-established prose-forms: the 'Arcadia' (1580–90) of Sidney, the 'Ecclesiastical Polity' (1592–7) of Hooker, the Essays (1597) of Bacon, are of widely differing kind and provoked little following. Even Lyly's 'Euphues' (1578–79) which was immensely imitated for a decade, produced no permanent form. The pamphlet or the tract is the one characteristic Elizabethan production: its master was Tom Nash, who poured forth numbers of these ephemeral pieces, of wonderful vigor and spirit. Of the same sort of prose the succeeding century showed much. The reign of Elizabeth had been a time for Englishmen to get together and establish their position against the world. Having made themselves a place, they turned to put in order their own house: the 17th century is a period of civil strife and contention. Literature could not avoid the effect of politics: the disturbance of opinion dragged with it into political or religious controversy many who might otherwise have found expression in literature. Even Milton for a dozen years wrote chiefly prose. We cannot, therefore, look for a varied and definite literary development. The greatest work of the century was in prose and the greatest and most influential single monument was the King James version of the Bible (1611). The spirit of the Bible is everywhere to be felt in the great prose of the time, transmuted into varying substance in the eloquence of Jeremy Taylor ('Holy Living,' 1650), the quaint richness of Fuller ('The Holy State,' 1642), the stately roll of Sir Thomas Browne ('Religio Medici,' 1643), the powerful vigor of Milton's prose — written during the Civil War, to answer in his own way the call of the country — and the intimate simplicity of Bunyan. A few other writers have little tincture of the struggle of the time, Overbury's 'Characters' (1614), Burton's 'Anatomy of Melancholy' (1621), Cowley's 'Essays' (1868), Walton's 'Compleat Angler' (1653) works of a widely different nature, but showing the quiet, contemplative side of the century that was so distracted by controversy. The Civil War occurred in the very middle of the century, and makes a definite bar at least with the poetry of the time. Before it was the Elizabethan age; after it the Restoration. The drama and the lyric before and after are different: even the external form of poetry shows a marked change. At the beginning of the century the verse was free and fluent: at the end it had become concise and brilliant. To the blank verse of Shakespeare succeeded the rhymed couplets of Dryden, organic power giving place to elegant skill. In point of time belonging to both, John Milton in reality belongs to neither. More fully than anybody else he is the representative of Puritanism in literature: its zealous rages, its fanaticisms, its blemishes, its love of liberty and of God give life to his prose tracts on church government, on divorce, on freedom of speech, on the acts of the people: its higher dreams and ideals and aspirations, its unattained possibilities of beauty in 'Paradise Lost' (1667), and his later poems.

With the Restoration of Charles II. began a new period in literature, often called the classic, most immediately noticeable in the drama. The influence of France in the direction of strictness of classic art and looseness of moral life, was strong: added to it was a change in stage conditions, which allowed the development of scenic effect. A realistic, if not spectacular, character, was given to the theatre and the Elizabethan plays, with all their poetry, fell out of fashion, save in versions of the day. A new set of dramatists sprang up to fulfill the conditions. Dryden was the chief, equally strong in tragedy and comedy and what he called the heroic drama, after French models. Otway had the greatest tragic genius ('Venice Preserved,' 1682), but could not so well adapt himself to the taste of the age. Congreve, Wycherley, Farquar and many others wrote comedies depicting a brilliant social world, but of such gross immorality that Jeremy Collier (1698) launched an attack on the whole theatre. His words had some effect and the drama became more decent, but as it really seems to have been quite representative of the life of the time (not artificial as Charles Lamb loved to think of it), the succeeding drama lacked vitality, and for a hundred years hardly a play was written which is now remembered. Addison's 'Cato' (1713), Rowe's 'Jane Shore' (1714), Gay's 'Beggar's Opera' (1728), Johnson's 'Irene' (1749), Home's 'Douglas' (1756), are noteworthy for various reasons, but not as constituting a powerful drama. It was in other directions that the 18th century was successful. In 1709 Richard Steele published a small paper every other day which he called the 'Tatler.' It was not precisely a newspaper, but consisted rather of a series of essays on all sorts of subjects, sometimes by Steele, sometimes by Addison, Swift, or a number of others, who lent occasional help to the enterprise. The 'Tatler' was very popular, and was brought to a close only to be continued in the 'Spectator,' in which Addison took the chief part. He took up the idea of Steele and found in it a form of expression exactly suited to his especial powers. His essays were popular in the best sense: they were read with delight by all sorts of people, but they dealt with subjects of intelligent interest. Addison was a student of human nature, an observer of life and character, a genial philosopher and all these elements of his nature were exhibited in the little essays which he wrote for the 'Spectator.' The success called forth followers: Addison and Steele followed their joint productions with separate publications, which were sometimes political as well as literary. Among the many 18th century periodicals should be mentioned the 'World' (1752), by Lord Chesterfield and others; the 'Rambler' (1750), and the 'Idler' (1758), by Samuel Johnson; the 'Bee' (1758), by Goldsmith. The influence of this sort of literature abroad was also very great: it continued even to the beginning of the 19th century, when a number of clever young men of New York, Washington Irving among them, joined in the production of 'Salmagundi' (1807). One distinguishing element in these periodical essays was that of personal character. Some imaginary person was the means by which they were put before the public; the 'Tatler' was edited by Isaac Bickerstaft, the 'Spectator' by a club of the Spectator and others, including the famous Sir Roger de Coverley. This personal element was characteristic of the century, which was extremely sociable and very much interested in human nature. These frequent sketches of character and observations of life and manners were not absolutely new even in England: so-called "Characters" had been not uncommon in the 17th century and were well known in France. This interest in character for itself is paralleled by an interest in life in action observable in the stories of Defoe. Defoe was a man who lived by his pen (one of the first who had not been connected with the theatre or the court), whose great gift so far as literature was concerned was his power of representing life. His famous 'Robinson Crusoe' (1719) attained inordinate popularity, not only for its adventurous incident, but for its power of realistic story-telling. A little more and these things would have been novels. Addison's 'Sir Roger de Coverley' papers are sketches of life and character without a story. 'Robinson Crusoe' and the many other stories of Defoe have too much action, without attention to life and character, in spite of their realism. These elements were combined by Richardson and Fielding: 'Pamela' (1741), 'Clarissa Harlowe' (1748), 'Sir Charles Grandison' (1753), by the former, were immensely read and influenced all Europe; 'Joseph Andrews' (1742), 'Tom Jones' (1749), 'Amelia' (1751), by the latter, are quite as excellent and somewhat more modern in form. Smollett followed with 'Roderick Random' (1748), 'Peregrine Pickle' (1751), and some others, which are a slight variation upon the first of Fielding's. Goldsmith's 'Vicar of Wakefield' (1766), and Miss Burney's 'Evelina' (1778), give us, the one the life of the country, and the other of the town, and we have the English novel of domestic life, a form of literature which for a hundred and fifty years has lost and gained but little in essential character. The essay and the novel were new: such things had been in England before, but never the definite literary understanding necessary to constitute a true literary form. Meanwhile the older forms of literature were not neglected. There had been no such histories in England before Clarendon's 'History of the Great Rebellion' and Burney's 'History of My Own Time.'

These men wrote of what they had seen, later writers learned to take a larger view and handle larger material. Robertson (‘Charles V.,’ 1769), Hume (‘History of England,’ 1754–61) and Gibbon (‘Decline and Fall of the Roman Empire,’ 1776–88), gave example of the combination of scholarly research and literary skill. Oratory also flourished in the exciting Parliamentary struggles which now took the place of court faction. Chatham, Burke, Fox, and many others created a standard and form of eloquence, which yet serves as a model for many speakers and a foundation for more. A special form of oratory becomes important in literature; sermons were vastly read. Barrow, South, Stillingfleet, Tillotson, published their discourses in the last half of the 17th century, and had many successors in the first half of the 18th. The interest in religion was a part of the general intellectual curiosity of the century; philosophy also became a part of literature. Locke's ‘Essay on the Human Understanding’ (1690) was more widely read than any other book of such a kind. Every one discussed a little philosophy, whether Christian or free-thinker. Berkeley was the former: his ‘Principles of Human Knowledge’ (1710) has been of importance in the development of metaphysical ideas. Hume was the latter, so much of a skeptic that his ‘Essays’ (1746) incited Kant, in Germany, to that profound examination of the human reason that has been the foundation of modern philosophy. The 18th century was a century of reason and of prose. Prose was first simple, either graceful as in Addison, nervous in Defoe, or everything in turn in the wonderful prose of Dean Swift, an unapproached master of satire. As the century continued, style became more elaborate, of great dignity and stateliness at its highest points (Gibbon and Burke) and even for ordinary purposes admirably effective as in the best of Johnson. The time was intellectual and loved the things of the intellect; hence its poetry was not such as to satisfy the more emotional periods that came after. It was too obviously didactic or satiric, for one thing. Dryden was the first great master on these directions with the ‘Hind and the Panther’ (1687), and the ‘Religio Laici’ (1682). In Pope the classic poetry (as it is called) came to perfection, the ‘Essay on Criticism’ (1711), and the ‘Essay on Man’ (1732), the ‘Dunciad’ (1728) and the ‘Rape of the Lock’ (1712), have never been equaled in English for their telling brilliancy. The followers of Pope caught something of his manner, but produced nothing great, save Goldsmith, who infused a charm into this as into every other kind of literature. Dr. Johnson wrote two strong poems, but his chief power lay elsewhere. The minor exemplars of the characteristic 18th century poetry are of far less value. Addison as a poet, Garth, Prior in ‘Solomon’ (1718), Young, the author of ‘Night Thoughts’ (1742), Blair, ‘The Grave’ (1743), even Akenside, the author of ‘Pleasures of the Imagination’ (1744), did not all write the characteristic couplet, but they are all of the classic school and all wrote that intellectual poetry that now seems so strangely unpoetic. In lighter forms of verse there were more successful practitioners, Prior and Gay and Swift, but in didactic and satiric poetry, save in the work of the greatest, the 18th century produced nothing permanent. But during the whole classic century there had existed, in its time had been growing, a feeling for other things than those which the reason could put into brilliant and elegant form. It found expression in various ways, chiefly in love for the mediæval past, before the classic conventions had been, and in a feeling for the present wherever those conventions did not exist, namely, in nature and in the heart of man. The first feeling came to expression in various ways, often imperfect, as when Thomas Wharton wrote ‘Runic Odes’ (1748), when Gray wrote poems inspired by the Norse, ‘The Fatal Sisters,’ ‘The Descent of Odin’ (1761), when Sir Horace Walpole imitated Gothic architecture in his house at Strawberry Hill. In 1760 Macpherson published what purported to be translations of Ossian (also ‘Fingal,’ 1762; ‘Temora,’ 1763), and whether they were genuine or not, the fact that they were read shows the interest that was felt in the remote past. In 1767 Chatterton found that he could gain a public for his poetry by pretending that it had been written by a monk of the 15th century. In 1765 Percy published the ‘Reliques of Ancient Poetry,’ a collection of old ballads, a kind of literature full of the spirit of the past, and absolutely different from the classic poetry of the day. There had been plenty of ballads printed before, even collections of old ballads (Ramsay's ‘Tea-Table Miscellany,’ ‘Evergreen’ (1724); and they had inspired a few, but now they became an immense influence. In the other direction, love of nature and sympathy with man. Thomson's ‘Seasons’ (1726–30) show his fresh and charming view of nature, though his use of blank verse and the Spenserian stanza was more in keeping with earlier times. Gray produced very little poetry, but his best, the famous ‘Elegy’ (1751) has none of the brilliancy and intellectuality which marked the century, and it is noteworthy that in stanza 15, where he originally wrote the classic names of Cato, Tully, Cæsar, he afterward put the national names of Hampden, Milton, Cromwell. Burns was far too much of a man to be bound or curbed by fashions, unless they had been far more congenial than those of the 18th century. He took inspiration from the ballads and songs of his own country and produced poetry which touched the heart at once. Cowper, though by no means like him, nor apparently of the character of a reformer at all, wrote with a sincere directness that belonged to an earlier or a later time. The turn of the century shows the characteristic works of the Romantic movement: ‘Tintern Abbey’ (1798) and ‘Michael’ (1800), by Wordsworth, may represent the poetry inspired by love of nature and sympathy with man. Coleridge's ‘Rime of the Ancient Mariner’ (1798), and Scott's ‘Lay of the Last Minstrel’ (1805, preceded by ‘Minstrelsy of the Scottish Border,’ 1802) stands for the delight in ballads and mediævalism. With these fine poems and others only less so, it is plain that a new form of art has appeared different *in toto* from the classic conventions of the 18th century. The first great excitement of romance was for strange adventure and the glowing life of the Middle Ages. Wordsworth was for the time unread, while the poetry of Scott delighted all. Scott, however, was eclipsed in the popular mind by Byron, who really was personally the very thing that Scott and the public admired. They longed to hear of men of lofty spirit and recklessness and devotion. Byron was such a man; in 'Childe Harold' (1812) he took England out of itself. In the 'Gaiour,' 'Bride of Abydos,' 'Corsair,' 'Lara,' 'Parasina' (1813–15), he presented figures full of the romantic spirit. As the century continued, however, that spirit expressed itself in all sorts of different ways. Wordsworth presents the common delight in nature, Shelley, noble ideas for the regeneration of mankind. Keats, the power of beauty. Succeeding poets go in much the same directions. Tennyson is the most representative poet of the century in presenting to us in forms of great poetic beauty, all the phases of the thought of the time, religious, scientific, patriotic, literary. Browning gives us a vigorous optimistic conception of life and work, presented in a wonderful series of dramatic figures. Morris, Rossetti, Swinburne (sometimes called preraphaelites) may be said to follow Keats in their love of beauty, which they seek not only in mediævalism, but throughout all history sacred and profane. Matthew Arnold's poetry has classic qualities of style and great elegaic charm of thought, but he rightly saw that his true field lay elsewhere. The drama has been weak for the whole century, although all the greater poets essayed the form. Only Browning and Tennyson had even temporary success on the stage, while the work of the professional play-writers have without exception failed of a place in literature. By 1800 the novel had become a definite form of literature. In the early years of the century Miss Austen, Miss Edgeworth, Miss Ferrier produced pictures of life in England, Ireland and Scotland, respectively, the first of surpassing excellence. A great change was effected by Scott in the Waverley novels (1814–31). It has been pointed out that the lasting power of these novels depends on their full and vital knowledge of Scotch life and character. Scott, at the beginning, had some idea of doing for Scottish life what Miss Austen had done for English. But the real immediate effect of the Waverley novels was to give an enormous impulse to the romance of adventure and scenery and costume, a romance which found its best expression in the historical novel. The Waverley novels are great historical novels, though, of course, some have little history in them, and they gave a conception and an inspiration which was not wasted. In 1825 appeared the first works of importance of G. P. R. James and of Harrison Ainsworth, who for a quarter of a century achieved a very considerable popularity, though they added but little to the possibilities of historical fiction. More powerful than either was Bulwer, whose first work appeared in 1827, and who for forty years produced not only historical novels, but novels of every kind, works of great talent, though the judgment of time refuses them genius. At much the same time two other writers somewhat extended the field of the novel: Marryat, by sea-stories, which remind one of Smollett; Charles Lever, by stories of the army as well as of Irish life. Brilliant historical novels have appeared through the century: Thackeray's 'Henry Esmond' (1852), and 'The Virginians' (1857); Kingsley's 'Westward Ho' (1855), Dickens's 'A Tale of Two Cities' (1859), Charles Reade's 'The Cloister and the Hearth' (1861), George Eliot's 'Romola' (1862), Blackmore's 'Lorna Doone' (1869), Shorthouse's 'John Inglesant (1880), Pater's 'Marius the Epicurean' (1885), constitute a series of remarkable value. But the great successes of fiction in the middle of the century were made in the long-familiar forms. Charles Dickens had many minor characteristics, and so had Thackeray, but their novels, as well as those of George Eliot, are novels of every-day life. In the main these three are realists, striving chiefly to depict the life that they knew and saw about them. So chiefly were those who came after them. The Brontés, George Meredith, Charles Reade, Anthony Trollope, William Black, Thomas Hardy, George Gissing, these are realists also, though in only the last two cases of the consistent type developed by their contemporaries in France. Some of them sought in every-day surroundings the romance of character like the Brontés, some could perceive the rich spirit of comedy like Meredith. But none felt the need more than once or twice of straying from the familiar life of England. Toward the end of the century the craving for romance began again: it had never been entirely quieted, but it did not come to full expression till Stevenson and Kipling. Both sought the romance of life and character and of the soul, but both were masters also of adventure and incident and striking circumstance and flowing background. Anthony Hope, Stanley Weyman, Conan Doyle, Maurice Hewlett, have in general followed, and in some cases surpassed them. A third development of the century has been in the path of criticism, which at first found expression chiefly in the periodical. The magazine has been one of the most characteristic elements of 19th century literature. There were magazines in the 18th century — the 'Monthly Review,' the 'Critical Review,' the 'Gentleman's Magazine' — but the chief periodical was the Addisonian essay. The 'Edinburgh Review' (1802) and the 'Quarterly Review' (1809) were the beginning of a new movement. 'Blackwood's Magazine' (1817), the 'London Magazine' (1820) and 'Fraser's Magazine' (1830), together with many weeklies and dailies, were the beginning of a flood of literature that is now the form most familiar to us. The influence was at first chiefly critical. Jeffrey, the first editor of the 'Edinburgh,' with Gifford of the 'Quarterly,' set the style of a criticism, which though often unfairly slashing and ridiculously high and mighty in tone, had merit often in expressing sincere and definite opinions in literature and politics. A sort of gaiety and even charm was given by Wilson, who wrote under the name of Christopher North, by Sidney Smith, and Lockhart. But the most important developments came in the field of the personal essay. The 'Essays of Elia' (1820) by Charles Lamb, go beyond the Addisonian essay in their unfettered expression of a charming personality. 'The English Opium Eater' (1821) of Thomas De Quincey, is still farther away from the 18th century in form and spirit, and so is the 'Table Talk' (1824) of Hazlitt. All these are sincere personal utterance, and in their sincerity and personality lies their strength. In the main we may call the work of these men critical, for they were all absorbed in letters, and their view of life was essentially a criticism of literature. Something more in the way of established form were the famous Essays (beginning 1825) of Macaulay. The most remarkable works of their time in the power of focusing wide reading and immense knowledge into forms of extreme brilliancy. A striking contrast is offered by Carlyle, who began by essays of the accustomed character, though not ordinary in style, but after some years produced 'Sartor Resartus' (1833), expressive of his own vigorous personality and thinking, more extraordinary in form than any of his later work, but not more original or powerful. Carlyle had by no means the immediate fame of Macaulay, but his influence on the thought of his time has been vastly greater. Both were historians as well as critics, and by their interest in life and sympathy with man they brought in a new and fascinatingly interesting kind of historical writing, which the later influence of Darwinism and of science in general, has done much to deaden. Hallam before them should also be mentioned, and Green after them. John Ruskin began his career as critic with what seemed the impossible task of dethroning false masters of painting, and establishing an ethical foundation for art. About 1850, having succeeded in his earlier task, he began a struggle against a much wider range of evil, which was not so fortunate. Matthew Arnold also understood the range of the critic as extending beyond the field of art: his views on politics and religion were an influence in the history of thought, but naturally will not last as long as his conceptions on literature. Walter Pater took even a wider view of art, being at home with painting, architecture, sculpture, as well as with literature. He represents the so-called «æsthetic» position which developed from preraphaelitism. In philosophy and science the century has been pre-eminent, and many great books have been produced. The last field hardly belongs to literature, although Darwin, Huxley, and Tyndall were masters of style and could make the results of scientific work absorbingly interesting. More might be said of philosophy and theology, though here little has been produced that will last as literature, except perhaps John Stuart Mill's 'Logic' (1843), Cardinal Newman's 'Apologia pro Vita Sua' (1864), and parts of Spencer's 'Synthetic Philosophy' (1860-1900), all of which stand as representative of important movements in the history of thought.

There are many histories of English literature. That of Garnett and Gosse is an excellent general account, richly illustrated by extracts and reproductions of manuscripts and prints. The three volumes on different periods by Saintsbury and Gosse cover the last four centuries in a convenient form. The work of Taine (translated by Van Laun) expresses his views of the development of literature from national life. That of Ten Brink (translated by Keneday) is unfinished, but covers the ground where German scholarship is strongest, namely, Anglo-Saxon and Middle English. Brandl, in Paul's 'Grundriss der germ. Philologie,' gives a very full and convenient summary. Morley's 'English Writers' is a very full account in ten volumes, but has not got beyond Shakespeare. The 'English Men of Letters' series provides lives of the greatest authors. Ward's 'English Poets,' and Craik's 'English Prose,' are valuable, giving a summary of facts, a criticism by a writer of note, and a number of extracts in case of all distinguished poets and prose writers.

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English Literature, Middle Period. The term Middle English may conveniently be taken to include the period 1100-1500. For more than a century after the Conquest, however, the majority of works produced and read in England were written either in French or Latin. Literature in the vernacular, which had sunk to a low level by the beginning of the eleventh century, did not revive materially until the reign of John. The Anglo-Saxon Chronicle, continued to the year 1154, and a few religious works, chiefly of linguistic interest, almost exhaust production in English during this era of transition. During the thirteenth century English began to compete with the other tongues for supremacy, and by the time of Chaucer its victory was assured, although French and Latin continued to be widely used. At first, the progress of the vernacular was greatly hindered by dialectical differences in various parts of the country. The West-Saxon and Kentish, the Mercian, and the Northumbrian of the earlier period had developed respectively into the Southern, Midland, and Northern, with some changes of boundary. Of these, East Midland was most important, as the dialect of London and Chaucer, and the parent of Modern English. The language as a whole shows very marked differences from Anglo-Saxon, not only in the addition of many foreign words, chiefly French and Scandinavian, but in changes in the vowels and diphthongs, in the disappearance of inflectional endings, and in a freer use of particles and connectives. The dialectical peculiarities gradually became less marked, until at the end of the period there was practically only one literary dialect, with the exception of Scottish.

The influence of Anglo-French and Anglo-Latin upon Middle English was exceedingly important. The Normans took great interest in historical writing after their settlement in England, as the Latin chronicles of such men as Ordericus Vitalis, Henry of Huntingdon, and William of Newburgh attest. About 1136 Geoffrey of Monmouth produced his fictitious 'Historia Regum Britanniæ,' a book condemned by serious historians, but of great significance for mediæval romance. It was later reworked in French rhymed versions by Gaimar and Wace. The Normans were fond of romantic stories, and even retold the deeds of various native English heroes in their own tongue. More serious historical work was done in French verse by such men as Garnier de Pont St. Maxence or Jordan Fantosme. Churchmen like Lanfranc and John of Salisbury wrote on theological matters, and there was early much activity in the new English Universities. Latin writing of a lighter sort is represented by the 'De Nugis Curialium' of Walter Map, or the 'Speculum Stultorum' of Nigellus Wireker. The Normans were a people of practical mind, and most of their literature consisted of utilitarian or devotional prose. Scientific facts, or supposed facts, interested them greatly. They were clever tellers of tales, both of the fabliau type and those pointing a moral. Especially noteworthy is the work of the poetess Marie de France (1175-

1185), who wrote a charming collection of *Lais*, and a book of fables, the 'Ysopet.' The rise of the drama on English soil was due almost wholly to the influence of the French.

Earlier Middle English literature is better studied by types than by authors. Originality, as a general thing, counted for little in mediæval days, and works in the vernacular during the 13th century were based almost without exception upon French and Latin models. The narrative literature is of far greater interest than the religious and didactic writing. The French metrical romances, artistic poems dealing with love and war, and intended for the higher classes, were rapidly made accessible to the English after the middle of the 13th century. The cycle of King Arthur and his knights was the most important and popular. A smaller and less favored division dealt with "the matter of France,"—the deeds of Charlemagne and his warriors. A third group is based on native English and Germanic themes—King Horn, Havelock, Bevis of Hampton, Guy of Warwick, etc. Stories of Troy and Thebes form a fourth class. The Troy-story deserves attention because of versions of the Troilus-Cressida theme by Chaucer, Henryson, Lydgate, and Shakspere. Romances of Eastern origin, with a few others not readily classifiable, complete the list. By the time of Chaucer, the metrical romances were showing signs of degeneration, and in the 15th century they died a lingering death. In strong contrast to these are the fabliaux, short witty rhymed tales, intended for the lower classes, usually of a satiric character, and frankly indecent. They were never as popular in England as in France, although stories of this type form the largest genre-division of the 'Canterbury Tales.' Pious tales, generally representing supernatural occurrences in every-day life, and beast stories, like the 'Fox and the Wolf' (13th century), were popular. Noteworthy, too, are the collections of stories, often, as in the case of the 'Gesta Romanorum,' used by preachers as *exempla* upon which to base homilies. Many romantic narratives reappeared in altered form in the ballads. These "stories in song" differed widely from the romances, being short, stanzaic, allusive pieces of unknown authorship, perpetuated among the people by oral tradition, and dealing with a great variety of material. The popular lyric—quite a different thing—is represented by such pieces as 'Sumer is icumen in,' or 'Blow, Northern Wind,' which strike a more truly English note than the art-lyrics of the period. Secular love-poetry was often applied to religious ends, as in the 'Love-Rune' of the Franciscan monk, Thomas de Hales. In the 14th century French lyrics were extensively imitated, as the work of Chaucer and Gower shows. As for metrical chronicles, three deserve especial mention. Most important is the 'Brut' of Layamon (ca. 1205), so called because it traces British history from Brutus. Although dependent upon earlier French and Latin work, it shows imaginative power and patriotic feeling. The same love of England appears in the chronicle of Robert of Gloucester (1298), which may have been written by more than one man, and in the historical work of Robert Mannyng of Brunne in the 14th century.

The devotional and didactic literature is somewhat difficult to classify, since the various types were not always clearly differentiated, and borrowed much from secular writing. A favorite form of conveying wisdom was the proverb poetry. An early collection of this sort was attributed to King Alfred, and another was put into the mouth of a personage called "Hending." A similar purpose was served by the "debates," the most noteworthy of which is the 'Debate of the Body and Soul' (12th century), in which each speaker accuses the other of being responsible for the death of the dead man. The 'Owl and Nightingale' (ca. 1220) is the most important secular debate in English. There was much work on scientific subjects, and this was often made to point a moral, as in the 'Bestiary' of the early 13th century, which appends a "significatio" to each description. A vast number of homilies and devotional treatises were written. The 'Poema Morale,' "a penitential sermon in verse," dates from 1170. The 'Ancren Riwle,' or Rule for Nuns, is an early prose monument of some importance. More celebrated is the 'Ormulum' (ca. 1200), a set of pedestrian metrical homilies valuable to the philologist on account of a peculiar system of spelling. In the 14th century, Dan Michel of Kent, the author of the 'Ayenbite of Inwit,' William of Shoreham, who wrote stiff didactic poems, Robert Mannyng of Brunne, who versified a French manual and gave it the title 'Handlyng Sinne,' and Richard Rolle of Hampole, are all noteworthy. Richard Rolle, the mystic, hermit, and preacher, was more important as a personality than an author, yet his works, of which the 'Prick of Conscience' is the best known, were esteemed in their day. Chief among Bible-paraphrases are an early version of Genesis and Exodus (ca. 1250), in the Midland dialect, and the 'Cursor Mundi,' written in the north. Legends and lives of the saints were much in demand, and huge legend collections were made for homiletic work. The Tales of the Prioress and Second Nun in Chaucer illustrate this genre.

The most prominent figure in Middle English literature is Geoffrey Chaucer (1340-1400). A Londoner by birth, he was brought up in the atmosphere of the court, took part in the French wars, was often employed upon diplomatic missions, and held various public offices. His literary work falls naturally into three periods. The first, extending to about 1372-3, when he first visited Italy, reflects the influence of French poetry. Besides a number of shorter lyrical pieces, most of which are not extant, the period includes a translation of a part of the 'Romance of the Rose,' and 'The Book of the Duchess,' a lament for the death of the wife of his patron John of Gaunt. The second period, which closes about 1385, reveals him imitating Italian models, particularly the works of Boccaccio. Here belong 'Troilus and Cressida,' 'Anelida and Arcite,' 'The Hous of Fame,' 'The Parliament of Foules,' and some stories later utilized in the 'Canterbury Tales.' This period shows a great advance in versatility and poetic power. The so-called English period, in which he attained the summit of his powers, has been held to include the 'Legend of Good Women,' but recent research puts much of it earlier, and makes plain the strong influence of French. The chief work of this period, and his masterpiece, is the 'Canterbury Tales.' The stories were borrowed from various sources; the plan of the whole resembles that of the 'Decameron,' but there is no evidence that Chaucer was acquainted with it. Besides the two prose Tales, Chaucer translated Boethius, and wrote a treatise on the Astrolabe. The chronology of his writings has not yet been exactly determined.

Four important alliterative poems of the latter half of the 14th century, written in the West Midland dialect, may be referred to one author, whose name has not been preserved: 'Sir Gawain and the Grene Knight,' 'The Pearl,' 'Cleanness,' and 'Patience.' The first of these is generally considered the finest of the metrical romances, because of its elevation of tone, descriptive power, and narrative skill. It is written in a highly artificial style of verse. 'The Pearl' describes the appearance of a beautiful maiden in Heaven, seen in a dream. It is probably to be interpreted allegorically, although the poem has often been held to reflect the grief of a real bereavement. The other two poems, which are of minor value, exalt the virtues indicated in their titles. Alliterative verse, without end-rhyme, was employed by William Langland, whose bitter satire contrasts with the genial irony of Chaucer. 'The Vision of Piers the Plowman' attacks the evils of the day by means of allegorical figures seen in a series of dreams. A continuation of the same material appears in the pieces called 'Do Wel,' 'Do Bet,' and 'Do Best.' The allegory is sometimes realistic and sometimes mystic. The 'Vision' appeared in three different versions in the latter part of the 14th century. It has been doubted that this is all the work of one man, and too much weight has been attached to supposed autobiographical evidence in it. 'Richard the Redeless' is generally assigned to Langland.

The fame of John Gower (died 1408) rests, apart from a series of French *ballades*, and minor pieces, upon three works, the 'Speculum Meditantis,' a moral allegory in French verse, the 'Vox Clamantis' in Latin, dealing with the social unrest of his day, and the 'Confessio Amantis' in English, his best-known poem. The 'Confessio' consists of a series of tales, strung on a thread of story. The priest of Venus is sent to «confess» the lover, and gives him instruction by means of tales illustrating the vices and virtues, with special applications to matters of love. Many of these tales are well and simply told, but the artificial and highly finished octosyllabic couplet soon becomes monotonous. The poem is too long (nearly 34000 lines), and is far inferior to the work of Chaucer. An enormously prolific poet, too, was John Lydgate. His long poems, like 'The Troy-Book,' or 'The Falls of Princes,' are tedious versifying; his minor poems and *Fables* show him at his best. As a disciple of Chaucer he stands with Thomas Occleve or Hoccleve, a more interesting personality, but less productive and accomplished than Lydgate. Occleve's chief work is 'The Gouvernail of Princes.'

The prose work of John Wycklif was primarily utilitarian. He was greater as a personality than as a writer, but his translation of the Bible (ca. 1380) did much to fix the form of the language, and his simple and direct sermons appealed strongly to the lower classes. He was assisted in translating the Old Testament by Nicholas of Hereford, and the whole was later revised by John Purvey. An undue importance has sometimes been attached to the fictitious 'Travels' supposed to have been made by a Sir John Mandeville in the 14th century. The book was originally written in French, but the facts of its authorship are not yet fully known. Though purporting to be authentic, it is full of grotesque descriptions of the East, mostly borrowed from mediæval travel-books.

The 15th century was a singularly barren era. England was almost devoid of poetry of distinction; the example of Chaucer inspired little in the south, and the Wars of the Roses had a most unfavorable effect upon literary production in general. Some advance was made in prose writing, however, through the interest taken in historical, legal, controversial, and religious subjects. Reginald Pecock, the great opponent of the doctrines which had been advocated by Wycklif, is remembered for his 'Repressor of Overmuch Blaming of the Clergy.' Sir John Fortescue, the author of 'The Gouvernance of England,' and the chroniclers Capgrave and Fabyan also deserve mention. Perhaps the most distinguished work of the century was Sir Thomas Malory's 'Morte Darthur.' This collection of romantic tales dealing with King Arthur and his knights, told in melodious prose with great skill and charm, was finished about 1470, and printed fifteen years later by Caxton. Of the life of Malory little is known. Although he invented little, he was no mere compiler, but a great literary artist. The introduction of printing and the publications of Caxton mark a new era in English letters. Much of the material which Caxton printed he translated from other languages himself. His activity exerted a strong influence in the development of English prose.

A compensation for the dearth in English proper in the 15th century appears in the emergence of Scottish literature. The first noteworthy work in this dialect, with the exception of certain legends and romances, is the 'Bruce' of John Barbour, whose life falls within almost the same dates as that of Chaucer. The poem partakes of the nature both of a rhymed chronicle and a romance, and though lacking in finish, is full of vigor, and animated by patriotic spirit. It celebrates the deeds of Robert Bruce, with occasional lapses from historical accuracy. Andrew of Wyntoun's 'Original Chronicle'—so called because he began from the very beginning—is an exceedingly monotonous piece of versifying. The exploits of William Wallace were celebrated by Henry the Minstrel, or Blind Harry, as he is often called, in a poem which takes great liberties with history. Blind Harry died about 1492. A pronounced imitator of Chaucer, and not an unworthy one, was King James I. of Scotland, who celebrated his love for Lady Jane Beaufort in 'The King's Quair' (1423). In structure, language, and general literary treatment it is highly artificial, but full of grace and poetic feeling. It derives additional interest from the romantic career and early death of its author. In variety and excellence of work, Robert Henryson, who flourished in the latter part of the 15th century, holds an important place. He wrote the earliest extant English pastoral, 'Robene and Makyne,' and a notable collection of 'Fables.' The influence of Chaucer is seen in 'The Testament of Cressid,' which describes Cressida's unhappy death with great dramatic power. In minor poems he was often felicitous. An elaborate, though tedious and awkward bird-fable is the 'Howlat' or 'Owlet' of Holland. The greatest poet of the period was William Dunbar (1460?-1520?), who led a wandering life in his youth, was later attached to the court of James IV. of Scotland, and entered holy orders. Most of his poems are short, and a large number of them are satirical. More ambitious are 'The Thistle and the Rose,' which commemorates the marriage of the king, and 'The Golden Targe,' an elaborate allegory. 'The Dance of the Seven Deadly Sins,' 'The Flyting with Kennedy,' a brother-poet, 'The Two Married Women and the Widow,' and 'Tidings from the Session' are all representative pieces. 'The Two Friars of Berwick,' a piece of vigorous Chaucerian narrative, is ascribed to him. 'The Lament for the Makers' strikes the elegiac note, but Dunbar was, on the whole, lacking in pathos and tenderness. He was a poet of great variety and originality, using both the "aureate style" then in vogue, and the rude dialect of the people with equal skill. Gawin Douglas, Bishop of Dunkeld (1475-1522) wrote rather stiff allegorical poems, 'The Palace of Honor,' and 'King Heart.' His most important work is his translation of Vergil. Douglas was the most learned of the Scottish poets, and his work was designed to appeal chiefly to the upper classes. Much of the work of Dunbar and Douglas falls outside the formal boundary of this literary period, 1500, yet in the general character of their poetry, and especially in their imitation of mediæval models they are properly to be considered with the earlier men. The same is hardly true of the work of Sir David Lyndsay of the Mount (1490-1545), who completes this group of Scottish poets. The reformatory tone and national appeal in his writings place them in the era following.

In English literature proper a similar distinction is to be made. Alexander Barclay's translation of the 'Narrenschiff' of Sebastian Brandt, which he called 'The Ship of Fools,' and 'The Pastime of Pleasure' of Stephen Hawes, a "belated Chaucerian," both produced in the first decade of the 16th century, belong far more to the age that had passed than does the poetry of Skelton. Although some of Skelton's early work suggests imitation of the older poetry, his most characteristic pieces do not fall within the bounds of Middle English. Neither Hawes nor Barclay were even second-rate poets; their prominence is chiefly due to the fact that they lived in a time when little poetry was written.

The Miracle Plays flourished in England from the early part of this period until the end of the 16th century. The Morality Play, a less important genre, arose in the second quarter of the 15th century, and, with the Interlude, for a time rivalled the popularity of the Miracles. For a discussion of the rise of the drama in the Middle English Period, see MIRACLE PLAYS.

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English Modern Political Development. The signing of the Magna Charta in 1215 by King John had sown the seed for future constitutional liberty. This came in the shape of the great Protestation in 1621, in which Parliament delegated unto itself the right to discuss state affairs; the Petition of Rights in 1628, prohibiting taxation without the consent of Parliament; the famous Bill of Rights, passed by the Convention Parliament of 1689; the Toleration Act of 1691, allowing Dissenters the freedom of public worship; and the establishing of triennial parliaments and the freedom of the press. At the close of the 18th century, England was an impoverished, benighted, and backward country. A reduced population of 10.000,000 was oppressed with an enormous debt, which it seemed to be hopeless to attempt to pay. America had been lost through a stupid attempt at subjugation, and Ireland was ripe at any time for revolt. Wealth was so unequally distributed that, while the artificial rise in wheat and land enriched the small class which controlled legislation, the bulk of the population was pauperized. The general level of education was so low that the attempt to introduce machinery into a country destined in large measure to live by means of it, led to riots. The press was shackled, the bench far from free, the civil service the football of patronage, and crime was steadily increasing, through the operation of a criminal code, so barbarously severe as to be worse than useless. Yet out of these unpromising beginnings has emerged the England of our day—the England of a great literary, scientific, commercial, and political people, a dominion on which the sun never sets, the country which divides with us the repute of having the greatest resources and greatest enlightenment of modern times, the home of individual freedom and honest administration.

The most marked trait of the management of their affairs by the English in modern times (and much of the dislike of them abroad has been caused by it) has been its commonplace rationality. The age which dawned upon the world with the American and French Revolutions was to Bentham and to Burke no less than to Paine, the Age of Reason, and reason in English minds has never been the abstraction which flourished under the same name in France and wherever French philosophy gained a footing. Pure democracies, as the pages of Athenian, of French, and of American history show, have a fondness for abstract principles of government, which is apparently connected with another recognized tendency of democracies — to be carried away by phrases. Both in France and America, the rise of democracy 100 years ago was marked by attempts to found the system on some broad theory, such as the rights of man, equality, or the social contract theory. All the great Americans who gave life and form to the movement ending in the complete democratization of our institutions, from Jefferson and Franklin to Lincoln, as well as the French constitution makers from 1789 to 1848, were impelled by the idea that they had discovered a new principle of government, which could solve the perplexities of its problem, bring to an end the oppression of man by man, and change the world from a vale of tears into an abode of happiness. To the more phlegmatic English, the Age of Reason was to be somewhat different and saner. Burke and Bentham and Adam Smith in their different fields were great rationalists; but they did not dream of making the world over. Bentham appealed to the principles of utility, the greatest good to the greatest number, a purely practical standard; the political philosophy of Burke, which first led him to sympathize with the American, and afterward to detest the French Revolution, was based on the simple truth, hitherto almost unrecognized and still only slowly establishing itself in the human mind, that the welfare and decay of states is governed by laws analogous to, and at many points identical with, those which determine the prosperity and failure in life of individuals.

Comte insists that all human knowledge passes through three stages, the religious, the metaphysical, and the positive or rational. There is no field in which the Comtean law seems to work more clearly than that of government. For ages mankind appeals to revelation and divine right; this idea being expelled, we are taught that "equality" or "natural right" is the true substitute. The final stage is reached when it is discovered that the only real appeal is to reason. All the great publicists of the 18th century guessed the secret. Their followers in England and America applied it.

A real Age of Reason can hardly prove an era of violent change. In England, since the Reform Bill of 1832, while institutions have been liberalized, nothing has been destroyed. The terrors of the law have been mitigated; its firmness has not been impaired. The press has been made free without being allowed to become licentious. Liberty of worship has been established, and in Ireland the connection between Church and state has been dissolved, but the Church has not been despoiled. Slavery has been abolished, but the slave owners compensated. The control of the crown and the great landlords over elections has been shaken off, and the House of Commons made strictly representative; but the freedom of the representative to act in accordance with his own convictions has not been tampered with. Trade has been made free, and this with absolute indifference to "reciprocity"; English ports are open to the trade of the whole world, no matter how much any other nation closes its own — the crowning triumph of Liberal ideas as to commerce. The old colonial system in all the large English speaking colonies has been abandoned, and a federal system of nearly independent states established in Canada and Australia. A blow at privilege in the army has been struck by the abolition of the purchase of commissions. The immense national debt left by the wars with France has been greatly reduced; and a nearly consistent policy of peace with foreign nations pursued. The land question in Ireland, the constant seed of trouble for centuries, has been disposed of, and all these things have been accomplished without resorting to violent or extreme measures or destroying any established institutions. These are the reforms dreamed of in the 18th century, some of them first introduced in England.

But the form and theory of the English Constitution are still wonderfully unchanged. It is the fashion to speak of the transformation of English society and government and law and manners which the last 100 years has introduced, as the "democratization" of English institutions; but the word would rather be rationalization. The state, the Church, the aristocracy, and the crown still exist as potent factors in the Constitution; privilege plays a great part in the law, and birth and family count socially for more than they are worth. The House of Commons has been democratized, so far as a wide suffrage can of itself effect this result, and the civil service has been thrown open, and the abuses which Burke said he loved to hear "clamored against," overthrown; but the actual control of the government is still to a great degree in the hands of the wealthy and titled classes.

The most important constitutional change of our day in the democratic direction was, curiously enough, unconsciously accomplished. When Bagehot published his account of the English Constitution in the sixties, few people in England were aware of how supreme the House of Commons had become, or how its supremacy had been obtained. Bagehot showed how the ministry (which actually carries on the government) had ceased to be the agent of the Crown, and grown to be a sort of committee representing the party having for the time being the majority of the Lower House. The Crown could no longer refuse to call Mr. Gladstone or Mr. Disraeli, as the case might be, to form a ministry; and as it was admitted that the House of Lords could no longer refuse to pass a bill persistently demanded by the people's representatives, the first inference seemed to be that the English government had become a parliamentary democracy with but a single chamber; without even the checks and balances of the American Constitution, or its division of powers and judicial control over the legislature. Sir Henry Maine was so much impressed with this idea that he wrote a book to prove that England had become a "pure" democracy. But even here the democratization of institutions was not nearly so complete as it appeared on the surface. Through all the changes of the century, the crown has remained in control of foreign affairs, at the head of the Church and the aristocracy; society and wealth have been its allies and the great equalizing influence of mere numbers which has played such a potent part in British politics, has obtained but a slight control in England.

Of course, it would be absurd to attribute the totality of progress in any country to a single cause. The advances made by science and invention count for much; and every country has had its share in the common progress which made the 19th century mark a turning point in the world's history. But when we reflect that in every country the great advance was preceded by a struggle between the advocates of freedom and the old order, in which the former were triumphant, and through which they obtained control and shaped the policy of government, the inference is inevitable that free institutions have enormously contributed to the advance. Those in any country who deny that its welfare is bound up with the rationalization of human institutions have no evidence to appeal to. The pages of their own past are black with the proof of human happiness, comfort, content, and peace, even in as moderate degree as they have yet been realized not only did not exist, but (as long as the final court of appeal in Church and state was authority and privilege) were regarded generally as a rather silly dream; they have advanced in the last 100 years *pari passu* with those rationalizing changes which in some countries have taken the form of democracy, and in England of deliberate and continuous institutional reform through the growth of popular power.

A generation had grown up which had enjoyed all the benefits of rational, free government, and yet had a comfortable state Church, a satisfactory aristocracy and magistracy, an army and navy officered by gentlemen, an excellent press, a well administered system of justice, a trained and honest civil service, and a full purse. The abuses which the old Liberalism had been called to destroy had been destroyed. Was it worth while to go on, after all this, to introduce democracy for the sake of making things systematic? America and France had both started pure democracies but England had secured the benefits of solid, good government without doing anything of the kind. It was not Imperialism which broke the Liberal party in two under Gladstone, and has kept it divided; it was the aversion for sweeping theoretic changes in the national habits which has always been characteristic of the English people.

The remoter causes which have led to the present reaction against Liberal ideas, the tide of which has been swelling for 25 years, are no doubt numerous and diverse. Following on a régime of reason, it seems in some respects like a reaction against reason itself; as if the new generation had got tired, as an individual might, of being reasonable, and were resolved to try something else. It has its economists, who teach that every country, if not every town, city and village, has its own political economy; its historians, who think that what really improves the human race is violence and war. Its poet sings the praises at once of law, order, discipline, violence, blackguardism, and brutality. The writers who heralded it, like Froude, Carlyle, and Ruskin, deified force or imagination, laughed at reason, and delighted in ridiculing the absurdities of the economists under the guidance of whose teachings English commerce and the English language have spread over the earth. Its publicists assure us that the secret of the permanent grandeur of free nations, is plenty of distant colonies, and a huge army and navy and its priests make a laughing stock of themselves and the religion they profess, by preaching the sword as the true means of spreading the gospel of peace. The reaction teaches that protection and government bounty, that is, taxation, is the true source of wealth, and that privilege is the buttress of common right. It is imperialistic and military —that is, it appeals to the passion for foreign dominion, to greed and pride, while it pretends to be democratic because it appeals to an extended electorate, though its success paralyzes every democratic impulse. But there are many causes tending to prevent even a reaction in England from going to extremes—among others the publicity in the glare of which most public events are now transacted. An instance of this is the publicity being brought to bear in all its phases on one of the most recent developments against the «open door,»—Mr. Chamberlain's crusade in 1903 for «protection.»

It may be observed that foreign relations—the stronghold of this and every other reaction —have never been rationalized in England, nor completely in any country. The foreign office is the only secret branch of government left; and through it the executive retains, no matter what the nominal constitutional checks, the privilege of plunging any country into war without notice, and of explaining the event in any way it chooses. At the same time, none of the great powers, even of those who have most to gain by it, is ready to diminish the risk of war by agreeing in advance to arbitrate its differences. This makes it almost as easy today as it was 100 years ago for a government to get up a war for one reason and inflame the public into support of it by other and totally different reasons. Experience shows that no government function that is secret can long be honestly and properly administered. This is why the doors not only of courts of justice, but of the legislature and other public bodies, have been thrown open. Perhaps the time will some day come when the same principle will be seen to apply to the transactions of states between themselves. The principle of arbitration would of itself entail publicity as to all international differences.

On the whole, modern political development in England tends to establish, among others, the following conclusions:

(1) That there is no intimate connection between the mere form of a government and national prosperity. In England we find, at the height of its prosperity, monarchy, artistocracy, and democracy existing side by side. In South America we find democratic forms producing very little prosperity.

(2) That the conservative opinion so long maintained that the popularization of institutions necessarily produces disaster, tumult, and anarchy is a mistake, the extraordinary prosperity of England having advanced *pari passu* with the popularization of her institutions.

(3) That one of the secrets of prosperity is the emancipation of trade and industry, so far as possible, from all forms of control. The «open door» of which we now hear so much is only an illustration of this principle.

(4) That public business cannot be managed behind closed doors without becoming the private business of those who carry it on.

(5) That wherever government is popular and representative, success in the management of public affairs is dependent wholly on conscious, determined effort at improvement, ex-

actly as is the case with individual effort at self-improvement in private life.

(6) That the way to secure competency, fitness, and honesty in the public service is to follow the methods pursued in private life.

(7) That the worst way to settle any public question is violence, that is, war. During the period of England's great prosperity, 1850–80, she engaged in no important foreign war except that of the Crimea, which was inconclusive and useless.

The enthusiasts of the 18th century were laughed at for putting these ideas into people's heads. The reactionaries of to-day are trying to disprove them. We have in the contemporary history of England a monumental indication that the task will be impossible. See BOER WAR; CRIMEA; GLADSTONE; PITT.

English Snipe, a name among American sportsmen for the common American snipe (*Gallinago delicata*).

English Sparrow. See HOUSE SPARROW.

Engrafting. See GRAFTING.

Engraving, the execution of works of art on plates intended for printing. Impressions from metal plates are named engravings, prints, or plates; those printed from wood being called indifferently wood engravings and wood-cuts.

Engraving on wood, intended for printing or impressing from, long preceded copperplate engraving. It is to Germany we are indebted for the choicest specimens of early wood engraving; and among these the works of Albert Durer stand pre-eminent for delicate yet spirited execution.

The first English engravers on wood worthy of notice are Edward Kirkall, born in 1695, and John Baptist Jackson, who died in 1754. But the art had no real vitality in England until the brothers Bewick, about the close of the 18th century, founded the English school of wood-engraving, which has since attained a position second to no other.

Copperplate engraving arose in the 15th century. Until then the art of engraving on metal had been confined to decorating sacred vessels, armor, services of plate, etc., with emblematic figures, and other pictorial and ornamental devices.

Although the earliest use of engraved copper plates for printing impressions on paper has been claimed for German artists, it is now generally agreed that the practice was first established by the Florentine goldsmith and engraver, Finiguerra, an impression from one of his works having been recognized as produced in 1440, the date of the earliest German print being 1460. The new art had, however, very soon spread over Italy and Germany, for before the close of the century many eminent engravers had risen in both countries.

A perceptible change in style about the end of the 17th century marks the rise of the modern continental schools of engraving. Since then the artists of France, Italy, and Germany, have rivaled each other in producing many noble specimens of their skill and industry.

Great Britain possesses no early engravers in the simple style worthy to rank with the continental masters; and it was not until the middle of the 17th century that a few English and naturalized foreign artists, by their successful cultivation of the compound process, gave an impulse to the art, which had hitherto languished in complacent mediocrity. The succeeding century produced many native engravers who contributed to raise the British school to high eminence. The most celebrated of these, Sir Robert Strange and William Woolet, may be regarded as the founders in Great Britain of the styles in which they respectively excelled.

In proceeding to describe the methods and the instruments employed in the different styles, we give precedence to line-engraving, not only on account of its demanding greater manipulative skill, and that in it the highest triumphs of the art have been achieved, but also because a description of the tools and many of the processes will include those used in most of the other branches.

Line-engraving.— As implied by the term this is executed entirely in lines. The tools are few and simple. They consist of the graver or "burin," the point, the scraper, and the burnisher; an oil-stone or hone, dividers, a parallel square, a magnifying lens, and a blind, or shade of tissue paper, to make the light fall equally on the plate. For leveling important erasures there are used callipers, a small steel anvil, a small pointed hammer, and punches.

On commencing a plate, the first procedure of the engraver is to make a careful outline of his subject upon thin paper, with a black-lead pencil. The next step is to lay the "ground" on the plate; and an essential preliminary is to thoroughly cleanse its surface. Copper is effectually cleaned by a mixture of fine whiting and turpentine spread over the heated plate, and when the turpentine evaporates, wiping off the whiting with clean rag. The most efficient means of cleaning a steel plate is a strong lye, or solution of the common black ashes of the shops, and turpentine. With this mixture the plate is repeatedly washed, and each time rinsed with cold water; finally, it is rubbed dry with a scrupulously clean cotton rag. The hand-vise is now attached to one corner of the plate, a small thick fold of paper protecting the face at that part; then the plate is laid face upward on a moderately hot iron; or, better still, a tin box filled with water, kept boiling by a charcoal stove, or spirit-lamp beneath. By this latter contrivance all risk of burning the ground, and thus making it unfit for etching, is avoided. When the plate is hot enough, the ball of etching ground is rubbed over the surface, the heat causing it to melt and ooze through its wrapper of silk. The ground is then spread by light and rapid strokes with the rounded face of the dauber, continued until every part is thoroughly covered with an equal thin coating. The ground must now be smoked while the plate is hot, by holding it face downward, and passing the flame of two or three wax tapers loosely tied together, rapidly to and fro and across its surface, till it becomes a clear shining black; but care must be taken not to burn it, by permitting the flame to rest an instant on one place. The plate being cooled the paper on which the outline is drawn is damped, placed carefully face downward on the plate, and secured in its position by small bits of bordering wax; another piece of paper, also damped, is next laid over it, and the whole passed through the roller-press used for printing plates. When the paper is lifted off, the pencil outline is found transferred in reverse to the shining black surface in clear silvery lines.

Etching.— To protect the outline and ground during this process, supports made of paper, wood, or leather, about one eighth of an inch thick, are fixed on the margin; resting on these the parallel square is laid across the plate for the two-fold purpose of supporting the hand and of guiding the point. In a landscape, outlining and etching in the parts go on simultaneously; but in an historical piece the outline must first be secured by dotting it in carefully with the point, and then all parts of the subject it is desirable to etch are proceeded with.

When the etching is completed the supports are taken off, and the bridge — a thin board, having cross pieces about one inch thick under each end — is laid across the plate to support the hand. The margins are then painted over with varnish of brunswick black thinned with turpentine, the entire surface of the ground carefully examined, and all breaks or scratches penciled over with the varnish which resists acid equally with the ground. When this hardens, a wall of bordering wax about an inch high is placed round the subject, and pressed firmly down on the plate to retain the acid which is now applied. It must be borne in mind that the spaces between the lines, however narrow, and all parts not touched with the point, are protected from the action of the acid by the ground. Nitrous acid mixed with three or four parts water and a little sal ammoniac is used to corrode copper. When poured on, small bubbles of fixed air rise out of and collect upon the lines; these must be continually brushed off with a soft feather, otherwise foul or irregular biting ensues. A quarter of an hour generally suffices to corrode the lightest parts to a sufficient depth and breadth. The acid is then poured off, the surface of the plate washed with clean, cold water, and gently dried with blotting paper, or by the wind of a pair of bellows. The light parts being protected by varnish, acid is again poured on, and the process is repeated till all the successive degrees of depth are obtained.

The biting-in being accomplished, a proof is taken preparatory to the next step toward completion. Finally, the burnisher is brought into play alternately with the graver and point, to give the last finish to all parts.

An almost incredible amount of laborious and carefully minute graving is required in a highly finished historical plate to bring out the proper effects of form, texture, relief, and to impart to it the unity, breadth, and mellowness of effect essential to a highly finished engraving; but many proofs and retouchings are necessary ere a satisfactory result is obtained.

Painters' or Amateur Etching.— This art is a favorite pursuit with amateurs and little practice in the use of the graver and dry point suffices for finishing this description of work.

Aquatinta.— This method, as first practised and still followed, has been already described. See Aquatinta.

Mezzotinto.— This process differs fundamentally from all other styles of engraving on copper or steel, inasmuch as in it the lights and gradations are scraped and burnished out of a prepared dark ground, whereas in other methods the shading is corroded or cut into a blank surface.

The Mixed Style.— This is based on mezzotinto, which, still forming the great mass of shading, is in this method combined with line and stipple in such proportions as the taste of the artist suggests. All the tools employed in other styles are required for this; the roulette being largely used in subordinate parts.

Engraving on Wood.— See Wood-engraving.

Mechanical and Photographic Process.— Engraving in recent times has suffered much from the rivalry of photographic and mechanical substitutes. The most important of these is known as photogravure or heliogravure. The beauty of the work produced by means of this process in the reproduction of paintings, of drawings in monochrome made for the purpose, and of photographs direct from nature, has raised it to a position of great importance. A photo-mechanical process which is much used in the reproduction of the plates of the older engravers and etchers, and in the production of intaglio etched plate-reproductions from pen drawings has been carried to great perfection, some of the work produced being almost equal to the finest original etchings. A positive photograph is taken of the drawing or engraving to be reproduced (that is, the lines are black, the whites clear glass); this is placed over a copper plate coated with a bituminous varnish, and exposed to the light. Where the lines of the photograph have protected the varnish from the light it remains soluble, but where the light has affected it through the glass it becomes insoluble. The varnish may then be dissolved from the lines and the copper exposed exactly as if the etching point had been used to make the drawing on an etching ground. The plate is then bitten in the usual manner, and finally touched up and improved with the graver. See Photo-engraving.

Engrossing, an act which, on ancient statute books, when the natural laws of trade were little understood, and political economy not even guessed at, was set down as a crime. It consisted in something similar to what nowadays is known as "cornering the market" by buying up the crops or the herds wholesale (Fr. *en gros*) before they were fit for use, in order to retail them at a great profit when they matured and were available for consumption. The offense was not only a statutory offense in England, but a crime in common law, and from the time of Edward VI. to that of Queen Anne laws were repeatedly passed for its repression. Even in the last century a prosecution for engrossing was witnessed in an English law court. In acts 7 and 8 Victoria, ch. 24, the offenses known as forestalling, engrossing, and regrating, or retailing at a profit, were abolished. In recent years there has been a good deal of litigation in the United States, and much discussion all over the civilized world with regard to the legality of corporations formed for the express purpose of monopolizing the trade in certain necessities or luxuries of life. See Combinations; Monopoly; Restraint of Trade; Trusts.

The term is also used to denote the careful transcription of a deed, statute, or other legal document, in large hand; and is often applied, in the United States, to the final and certified copy of a statute, which is ready to be signed by the President, or the governor of a State.

Enharmon'ic (from Gr. *ἐναρμονικός*, in accord) in Greek music, a mode little known about, but distinguished by the use of small intervals or quarter tones, such as the tetrachord of which the first two steps were quarter steps and the third a major third. In modern music used as a general term to denote a difference in degree but not in pitch, though specifically there is a slight variation of pitch, which the same note takes according to its adjustment to a fundamental *tonic.* Thus C♯and D ♭ are practically the same note on keyed instruments, yet strictly speaking, the former should be produced by 15-16 of the whole string sounded, the latter by 9-10. An enharmonic change of key, that is shifting from one scale to another, as in transposing C♯to D ♭. often enables a composer to write more easily by avoiding recurrent accidentals.

Enhuber, ĕn'hoo-bĕr, **Karl von,** German painter: b. Hof, Bavaria, 16 Dec. 1811; d. Munich 6 July 1867. He studied at Munich, at first being known as an animal painter and later applying himself to romantic and humorous themes. He was made an honorary member of the Munich Academy 1858, and wears the order of St. Michael. Among his works are: 'The Dying Gunner'; 'Poachers'; 'Smoking Boy'; 'Interrupted Game of Cards'; 'Grandfather's Delight'; 'Wood Carver in His Shop'; and 'Stage Coach at the Tavern.'

Enkhuizen, ĕnk'hoi-zĕn (Lat. *Enchusa*), Holland, a town on a projection in the Zuyder Zee, 29 miles northeast of Amsterdam. It was once a place of great importance and had an extensive commerce, and a population of 40,000. Pop. 7,050.

Enna, ĕn'ạ, or **Henna.** See CASTROGIOVANNI.

En'neking, John Joseph, American painter: b. Minister, Ohio, 4 Oct. 1841. He studied at Munich and Paris, and was a pupil of Bonnat and of Daubigny. He paints chiefly landscapes and figure paintings. He received honorable mention at the Paris Exposition of 1900, and among his works are: 'Moonlight on the Giudecca, Venice' (1876); 'Freshly Picked'; 'Drove of Cattle on a November Day' (1878); 'The Obersee'; 'Farmyard Scene in France'; 'November Twilight' (1881); 'Summer Twilight' (1883); 'Indian Summer' (1885); 'The Coming Storm'; and 'Springtime.'

Ennemoser, Joseph, yō'sĕf ĕn'ĕ-mō-zĕr, Austrian medico-philosophic writer: b. Tyrol 15 Nov. 1787; d. Egern 19 Sept. 1854. He fought in the rising of the Tyrolese against the French 1809. After the Peace of Paris he went to Berlin, where he finished his studies and, 1816, took his degree in medicine. In 1819 he became professor of medicine at the new University of Bonn. In 1841 he went to Munich, where he obtained great reputation by the application of magnetism as a curative power, and published several works on that subject.

Ennery, Adolphe Philippe De, ä-dōlf fē-lēp dĕn-nĕ-rē, French dramatist: b. Paris 17 June 1811; d. there 26 Jan. 1899. He began life as a clerk, but later turned to the drama; studied scenic effects, the quick change from the tragic to the comic, and the contrast between the serious and ludicrous characters. He subsequently became the master of modern melodrama, producing alone and in collaboration some 200 plays. During the 50 years of his active life he accumulated a fortune of $1,200,000. His most successful plays include: 'Taking of Peking'; 'Mary Jane' (1845); 'Two Orphans' (1873); 'Martyrdom'; 'The Grace of God'; 'Grandmother.'

Ennes, Antonio, än-tō'nē-ō ĕn'näs, Portuguese dramatist: b. Lisbon 1848. He was for some years prominent in journalism, and afterward held high government offices. His first play, 'The Lazarists,' had extraordinary success in Portugal and Brazil, and long held the stage. It was followed by the comedy 'Eugenia Milton' (1874), and the dramas 'The Troubadours'; 'The Mountebank'; 'The Emigration'; 'A Divorce.' The last was translated into Italian and French.

En'nis, Ireland, town, in county Clare, on the Fergus, 19 miles northwest of Limerick. It contains a Roman Catholic college and Ennis College, founded by Erasmus Smith. O'Connell's monument and the ruins of a 13th century Franciscan abbey are among its attractions. A considerable trade in grain, flour, and agricultural produce is carried on, and large fairs and markets are held. Pop. 5,460.

Enniscorthy, ĕn-is-kôr'thĭ, Ireland, town, in the county of Wexford, situated on the river Slaney, 77 miles south of Dublin. There is an old castle erected by one of the early Norman conquerors, and in the neighborhood is Vinegar Hill, the scene of a skirmish in 1798 when the town was stormed by the rebels. The river Slaney is navigable, and there is a considerable trade in provisions. Pop. 5,648.

Enniskil'len, Ireland, a borough and market town of county Fermanagh; 37 miles northeast of Sligo; on an island in the river Erne, which connects the upper and lower sections of Lough Erne. Suburbs are on the adjoining mainland. In its town hall are kept the flags of the battle of the Boyne. The battle of 1689, between the forces of James II. and William III., in which William's forces were victorious, took place here. The noted regiment called Enniskillen Dragoons, or 6th Dragoons, were first formed from the defenders of the town at this battle. The manufacture of cutlery, straw hats, shirts and collars, and the tanning of leather are carried on here, and the trade is considerable. Pop. 5,570.

En'nius, Quintus, Latin poet: b. Rudiæ, near Brundusium, 239 B.C.; d. 169 B.C. When he was 38, Cato the Censor brought him to Rome, where he soon gained the friendship of the most distinguished men, and instructed the young men of rank in Greek. With an extensive knowledge of the Greek language and literature he united a thorough acquaintance with the Oscan and Latin tongues, and exerted great influence on the last. He wrote an epic poem in hexameters, 'The Annals'; tragedies and comedies; satires, epigrams, precepts, etc., but nothing now remains but fragments given as quotations in other ancient authors, many of them mere citations by grammarians and other insignificant extracts. A few larger fragments have been preserved, which give a favorable impression of his genius. His success in his own day was great. His poems were for a long period read aloud to admiring multitudes, and they were often quoted and referred to by the great writers of antiquity. See Sellar, 'Roman Poets of the Republic.'

Enns, ĕns, river in Austria, has its rise in the Alps of Salzburg, flows north-northeast, and then takes a northwesterly course into the Danube. Length about 160 miles. It divides Austria into Upper Austria and Lower Austria.

E'noch, Hebrew patriarch. He became the father of Methuselah at the age of 65 years; and we are told that he «walked with God,» and at the age of 365 years «God took him.» The words quoted are generally understood to mean that Enoch did not die a natural death, but was removed as Elijah was. The book of Hebrews (xi. 5) confirms this view. Enoch is the name of three other persons in the Bible, one of them being the eldest son of Cain (Gen. iv. 17).

Enoch, Book of, an ancient apocalyptic work in the Ethiopic language, of an assumedly prophetical character, of considerable importance on various accounts, and particularly because of its quotation by St. Jude in the 14th and 15th verses of his epistle. It is referred to by many of the early fathers, and Tertullian believed it to be canonic. Latterly it became discredited, and finally was lost to the Western Church, being known in Europe only by the references of these and other early writers. Bruce, the celebrated traveler, in 1773, discovered two Ethiopic manuscripts of it in Abyssinia, where it was still extant, and brought them home with him. Other manuscripts were subsequently found, and it has since been repeatedly translated and criticised in Europe, the Ethiopic text having also been published. The best translation (with commentary) is that of Prof. Charles: 'The Book of Enoch' (1893). According to him 'The Book of Enoch' as translated into Ethiopic belongs to the last two centuries B.C. All the writers of the New Testament were familiar with it, and were more or less influenced by it in thought or diction. The Ethiopic version was translated from the Greek, but the original was in Hebrew or Aramaic. It consists of revelations supposed to have been made to Enoch and Noah. These refer to the state of future blessedness, to judgments upon the wicked, and to the coming of the Messiah. They are full of elaborate imagery founded on the Book of Daniel and other portions of the Old Testament, upon which the dogmatical teaching of the Book of Enoch is also founded. Prof. Charles regards it as having been based on five separate treatises, which were fused together and modified in various ways, the final editor having made use of a lost apocalypse, called the Book of Noah. See 'Encyclopædia Biblica,' Vol. I. (1899).

Enoch Arden, a narrative poem by Alfred Tennyson (1865). Its theme is the return of a shipwrecked mariner to his home after a lapse of several years, only to find that his wife has married in his absence, believing him dead.

Enomo'to, Buio, Japanese statesman: b. Tokyo. He was educated in Europe, and returning to Japan in 1867, became the first president of a republic which he established in the island of Yego, but was ousted by the Japanese army 1869. After imprisonment for two years, he was appointed vice-admiral in the Japanese navy 1874. He served as minister plenipotentiary to Russia and became a member of the council of state and minister of education 1888, minister of foreign affairs 1891, and minister of agriculture and commerce 1892, which office he held for four years.

Enos, ā'nōs, Turkey, town on the north coast of the Ægean, 70 miles south by west of Adrianople. Pop. 7,000.

Enriquez Gomez, Antonio, ăn-tō'nē-ō ĕn-rē'kĕth gō'mĕth (properly ENRIQUEZ DE PAZ), Spanish poet; son of a converted baptized Portuguese Jew: b. Segovia early in the 17th century. He entered the army in his 20th year, and rose to the rank of captain; but in 1636 fled to Amsterdam, and, having there professed the Jewish faith, was in 1660 burned in effigy at a Seville auto-da-fé. The date of his death is not known. For his 22 comedies, of which some passed as Calderon's, and his poems, consult Ticknor, 'History of Spanish Literature.'

Enschede, ĕns'HA-dĕ, Holland, town in the province of Overyssel, 30 miles east-northeast of Zutphen. Rebuilt since its destruction by fire in 1862, it has large yarn- and cotton-mills. Pop. 16,178.

Ensenada, ĕn-sā-nä'dā (Spanish, a creek, cove, or bay), Argentina. (1) Seaport in the province of Buenos Ayres, the port of La Plata. (2) Seaport of Mexico, in the northern part of Lower California, on the Pacific coast, at the head of the Bay of Todos los Santos.

Ensign, the flag or colors of a regiment, in England, consisting of a field of white, blue or red, with the union in the upper corner, near the staff. Of naval ensigns the white flag is confined to the royal navy, the red to the merchant service, the blue to the naval reserves. In the American navy the ensign is the national flag, and it is also flown by the merchant service. In England, up to 1871, the lowest grade of commissioned officers in a regiment of infantry, by the senior of whom the regimental ensigns or colors were carried. The name is now abolished, the title of 2d lieutenant being substituted for it. Also the title of the lowest grade of commissioned officers in the United States navy.

Ensilage, ĕn'sĭ-lāj. See SILAGE.

En'statite, a native silicate, chiefly of magnesium, but also containing more or less iron and aluminum. The mineral commonly occurs in massive or fibrous forms, but distinct crystals, prismatic in habit, and belonging to the orthorhombic system, are also occasionally found. Its color varies from white to green. Its hardness is 5.5, and its specific gravity about 3.2. Enstatite is a common constituent of peridotites, crystalline schists, and meteorites, and is also associated with certain serpentines. It belongs in the pyroxene group, is insoluble in hydrochloric acid, and before the blow-pipe it fuses only along its thin edges. The name (Greek, «adversary») refers to these refractory qualities.

Entab'lature, in architecture, the horizontal, continuous work which rests upon a row of columns, and belongs especially to classical architecture. It consists of three principal divisions, the epistyle or architrave immediately above the abacus of the column, next the frieze, and then the cornice. In large buildings projections similar to and known also as entablatures are often carried round the whole edifice, or along one front of it.

En'tada, a genus of leguminous plants containing about a dozen species of climbing tropical shrubs, remarkable for the great size of their pods. *E. scandens* has pods which measure from six to eight feet in length. The seeds have a hard, woody, and beautifully polished shell, and are often made into snuff-boxes, scent-bottles, etc.

Entail', the settlement of an estate so that it shall pass according to a certain rule of descent. In England after the Norman Conquest estates were frequently granted to a man and the heirs of his body, but in time the law courts interpreted such grants as conferring a fee simple conditional, so that when the condition, namely the begetting of an heir, was fulfilled, the estate became a fee simple absolute and could be alienated by the grantee. The statute 'De Donis Conditionalibus,' passed in 1285, declared that this interpretation was contrary to the intention of the grantors, and enacted that in all future grants of this nature the grantee should have no power to alienate the estate, and that on the failure of issue the land should revert to the grantor. The effect of this statute was to prevent the free conveyance of land, but gradually the lawyers created a series of proceedings, known as fines and recoveries, by means of which a tenant in possession could bar the entail and convert his estate-tail into a fee simple, that is, into his absolute property. (See Fee, Estate.) These remedies created by the courts were abolished by the Fines and Recoveries Act, passed in 1833, and a direct means of barring entails was introduced. This statute enacts that every actual tenant-in-tail shall have full power to dispose of, for an estate in fee simple absolute, or for any less estate, the lands entailed, but a tenant-in-tail in remainder, expectant on an estate of freehold, cannot bar the entail, though he may bar his own issue, without the consent of the «protector of the settlement,» who is usually the tenant for life.

Entasis, ĕn'tā-sĭs, in architecture, the delicate outward curve of a column, found in perfection in the Doric column, by which an arc is described whose highest point is about midway between capital and base. This swelling of the column is intended to counteract the optical error by which a rigidly straight perpendicular line has a tendency to appear concave. The entasis is also calculated to suggest life and motion in the column under the superimposed weight of the entablature.

Entelechy, ĕn-tĕl'ē-kĭ, a Greek word meaning «the bringing to completion»), in the peripatetic philosophy of Aristotle is the transition or connecting action between what he calls δύναμις, potentiality, and ἔργον, actuality; that which, among the schoolmen, is conceived as intervening between the *posse*, and the *esse*, for example, between the infinite possibilities of omnipotence in the Supreme Being, and their manifestation in creation and active providence.

Entel'lus Monkey, or **Hoonoomaun**, an anthropoid ape or monkey included in the family *Simiadæ*. Its general name is *Semnopithecus, pithecus* standing for ape, and the rest of the word signifying sacred, or holy. This name has reference to the superstitious veneration in which the animal is held by the people in the land of its nativity. The specific name *entellus* contains the idea of command, and may refer to its head-dress, suggesting a reason for the worship it receives. In structure the animal conforms to the features which mainly distinguish the Old World monkeys from those of the New World, among which characters are: (1) the downward direction of the nostrils; (2) the presence of an opposable thumb; and (3) a non-prehensile tail. The body measures 22 inches, the tail 38 inches, and the weight is about 20 pounds. The color of the body is light yellow, the outside surface of the limbs chocolate, the hands and feet black. The hair radiating from a point on the forehead forms a crown for the head and a visor to protect the eyes. The range of this species is restricted to the southwest provinces of the river Ganges in India. Although the hoonoomaun is supposed to embody the spirit of a deceased human ancestor, its habits are mischievous and destructive, and it commits great havoc where it is protected.

Entente Cordiale, ŏṅ-tŏṅt kôr-dĭ-ăl, in politics, a term used in international politics, signifying a certain cordiality, based either upon sentiment or community of interest between nations and rulers. It is a relation closely bordering upon an alliance.

Enteralgia, ĕn-tē-răl'jĭ-ạ. See Enteritis.

Enter'ic Fever. See Typhoid Fever.

Enteritis, an inflammation of the small intestine, the most important symptom of which is diarrhœa. Different varieties of enteritis are described as catarrhal enteritis, the acute enterocolitis of children, or cholera infantum, croupous enteritis, and enteritis due to tuberculosis, carcinoma, and other malignant diseases. In primary enteritis the symptoms may be acute or chronic, the most important single symptom being diarrhœa. The stools are thin and watery, and particles of undigested food may be found in them. There is usually colicky pain with gas, and occasional vomiting. Loss of appetite, thirst, and dry tongue are usually present, but fever is not common. The general causes of catarrhal enteritis are improper food, particularly in children, unripe fruit, toxic substances, changes in the weather, and nervous influences bringing about changes in the character of the secretions and in the muscular activities of the walls of the intestines. Infectious diseases may also be the cause of acute enteritis. Rest in bed, following a mild laxative such as calomel or castor oil, together with milk diet, will usually be sufficient treatment for the simple cases.

Acute enteritis of infants, known as cholera infantum (q.v.), is a much more serious disease. This is a form of dysentery, in which not only the small intestine but the large intestine also is involved, and the most active cause of this disease is a specific micro-organism called the bacillus of Shiga. Treatment of acute enteritis of infants requires trained medical advice. The most important feature, however, in infants is to cut down the feeding, giving practically nothing but water for at least 24 to 36 hours. See Cholera Infantum; Colitis; Dysentery; Intestines, Diseases of.

Enteroclysis, a form of intestinal hydrotherapy of much importance. It consists in lavage of the intestines. The ordinary hot-water enema is the simplest form of enteroclysis, but true enteroclysis consists in continuous irrigation with large quantities of solution, either with a single or a double tube. The effect of the introduction of large amounts of hot salt solution (a dram of common table-salt to a pint of water, at a temperature of from 110° to 118° F.) is very marked. There is much increase in the tension of the pulse, and pronounced stimulation of the heart-action, both of prime importance in the treatment of hemorrhage, shock, asphyxiation from drowning or from coal-gas poisoning, and of many forms of drug and industrial poisoning. Enteroclysis has also a marked effect in augmenting the secretion of the kidney, and proves of immense importance in the treatment of chronic uræmic poisoning, such as is seen in Bright's disease, and also in the treatment of diabetic coma. It is likewise of importance in bladder troubles, in colitis, in peritonitis, septic endocarditis, and in ulcerative conditions of the large intestine, such as are found in dysentery and in cholera. Enteroclysis is also an excellent mode of treating collapse in chronic alcoholism.

En'terprise, The, an American 12-gun schooner with a brilliant naval career; one of the steadily "lucky" vessels. Built 1799 to deal with the French privateers in the West Indies, she had an extraordinary cruise in 1800: in a six-months' run she took 8 privateers, some of them much heavier than herself, and aggregating 47 guns, besides recapturing 4 American merchantmen. Sent to the Mediterranean against the Barbary pirates, she captured a 14-gun Tripolitan after a fierce engagement, and later was at the bombardment of Tripoli. But her finest battle was with the English brig Boxer, Capt. Blythe, on 5 Sept. 1813, off the Maine coast, toward Monhegan Island. She had then 16 guns, and was under Lieut. William Burrows; the Boxer had 14. The crews were about 100 each. The fight began at 3.20 P.M., and was ended at 4 by the Boxer striking, literally cut to pieces in hull, masts, rigging, and spars, several of her guns dismounted, boats and quarters shattered; while the Enterprise was almost uninjured, with but one shot in the hull and one in the mainmast. Both commanders were killed. American loss, 2 killed, 10 wounded; British, 4 killed, 17 wounded.

En'toderm (also called entoblast or hypoblast), the innermost layer of cells in the developing embryo. In man it subsequently develops into the epithelium that lines the digestive canal and its appendages, the pancreas, liver, lungs, etc. See EMBRYOLOGY.

Entomological Societies. Half a century ago a single entomological society was all that had been organized in the United States, but at the present time there are probably upward of a score of organizations devoted to this science. The first entomological society of which we have record was formed in 1842, and was The Entomological Society of Pennsylvania, which has long been out of existence. The American Entomological Society of Philadelphia was founded in 1860 under the name of The Entomological Society of Philadelphia, and published 'Proceedings' until 1868, when the society name was changed and the publications became known as 'Transactions.' This, as well as some of the other societies that will be mentioned, is supported by a permanent endowment fund, owns very extensive and valuable collections and a library, which are deposited with the Academy of Natural Sciences of Philadelphia, of which institution its members are associate members of the entomological section. Under the combined auspices of these organizations there is now published 'Entomological News,' which completed its 13th volume in 1902. The Entomological Society of Ontario publishes the 'Canadian Entomologist' which has reached its 35th volume and annual reports. It began publication in 1868, though the society had a previous existence under the name of The Entomological Society of Canada. It is supported by an annual government grant of $1,000 and the sale of its publications. The Brooklyn Entomological Society was organized in 1872, and in 1888, while retaining a corporate existence, became merged in the Brooklyn Institute, forming the department of entomology of that institution. It published 7 volumes of a 'Bulletin' and 6 volumes of 'Entomologica Americana,' but has temporarily discontinued publication. The Cambridge Entomological Club was founded at Cambridge, Mass., in 1874, and publishes 'Psyche,' a quarterly originally devoted largely to bibliographical and biological entomology. The same year The Entomological Club of the American Association for the Advancement of Science was formed. In 1884 The Entomological Society of Washington was organized, publishing 'Proceedings.' The Association of Economic Entomologists, as has previously been mentioned, was established in 1889. Its 'Proceedings' are published in the general series of bulletins of the Division of Entomology of the United States Department of Agriculture. In the year 1881 The New York Entomological Club began the publication of 'Papilio,' but at the end of its 4th volume its members joined the Brooklyn Entomological Society. In 1892, however, another society was organized in New York as The New York Entomological Society. It was incorporated in 1899, and issues a quarterly 'Journal.'

In addition to these, the principal publishing entomological associations of the United States and Canada, there are several entomological sections of larger scientific societies in Canada and in the United States. There are also local clubs or societies in various sections, for example, in Newark, N. J.; at Williamsburg, N. Y.; at Chicago, Pittsburg, and in San Francisco, the home of the California Entomological Society.

There are many foreign societies, nearly all of the largest cities of Europe supporting one or more, usually holding titles significant of an entire nation, for example, there are entomological societies of Belgium, France, Switzerland, Russia, Italy, and Germany, and others representing the cities of London, Berlin, Vienna, and Stockholm. See also AMERICAN ENTOMOLOGICAL SOCIETY.

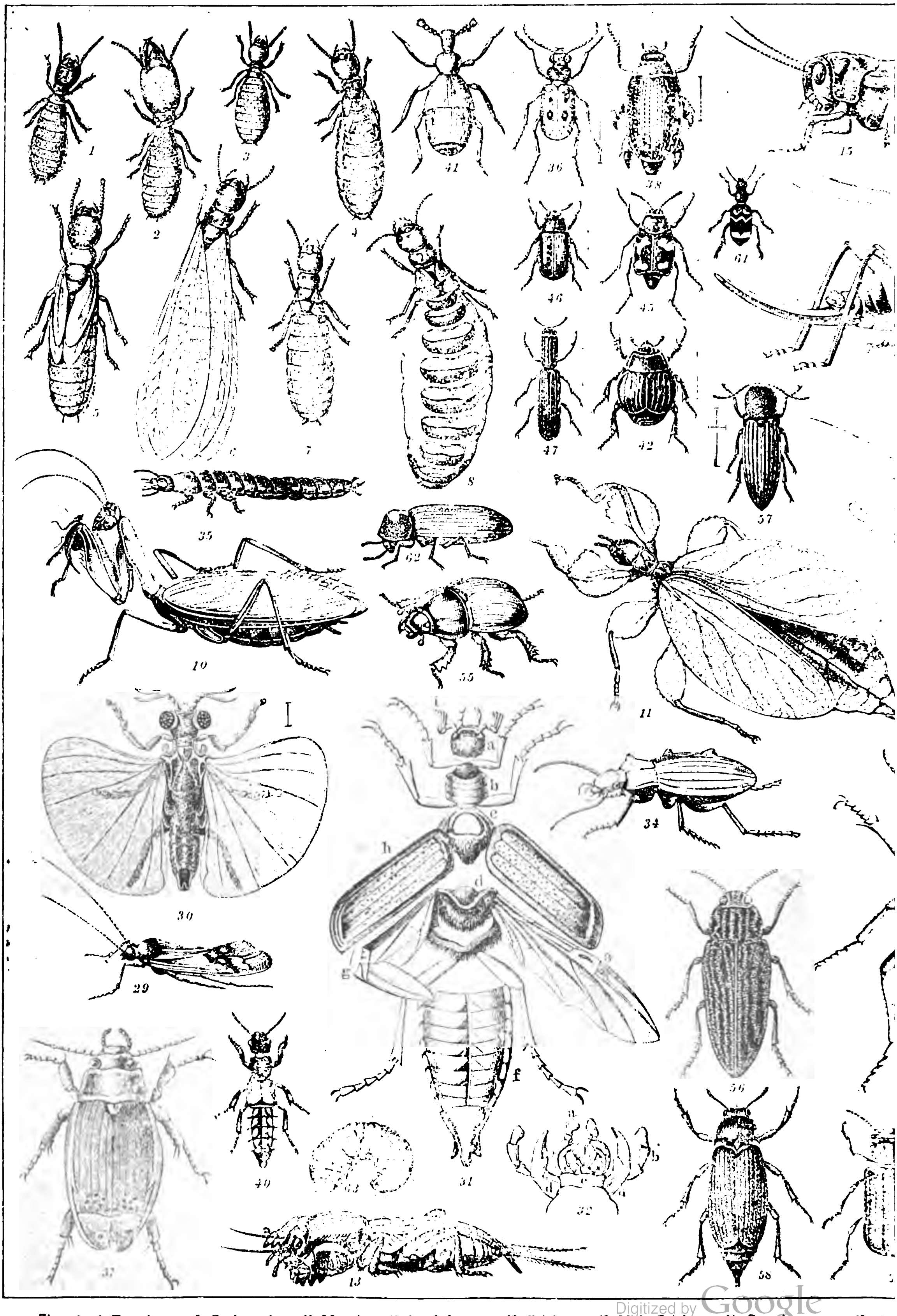
Entomology, the science which deals with insects. See INSECTS.

Entomology, Economic. Attacks by insects upon useful plants doubtless began with the first cultivation of plants. But it was not until the end of the 18th century that any means for mitigating their ravages were employed beyond hand methods and other purely mechanical measures. A few crude efforts were made among the ancient farmers and fruit-raisers on the shores of the Mediterranean toward the suppression of insect-pests, and Pliny even advised the use of white hellebore, one of the modern insecticides; but it was at about the middle of the 19th century that insecticides (q.v.) or insect poisons began to be generally adopted, and the migration of the Colorado potato beetle from its native home in the Rocky Mountain region to the potato fields of the East was the indirect means of the employment of arsenical preparations as a means of destroying insects; so that this insect, while an apparent curse, has proved, indirectly, of the greatest value to the agricultural community at large. Prior to the use of Paris green, which appears to have first been applied to this potato pest in Michigan in 1867, knocking the beetles from the infested plants into a pan of water, was the only method of treatment, and was used for many other insects as well. The discovery of the value of this poison as a remedy for the codling moth was made in 1878, by Prof. A. J. Cook, who used Paris green as a remedy for canker-worms, and found that the trees treated with it were free from codling moth. To Prof. Cook also is probably due the first use of kerosene mixed with soap, although the kerosene emulsion, which is now a standard remedy for all sucking insects, was the joint product of Messrs. Barnard, Hubbard, and Riley, and first used in 1877. White arsenic was employed as an insecticide as early as 1871, and London purple was put to practical use in the destruction of the cotton-worm in 1878. London purple has since been displaced by various other insecticides, as it has proved inferior to Paris green, which, in turn, has been replaced by arsenate of lead, because the latter, while poisoning the insects, does not scald or otherwise injure the plants. In the same manner that the discovery of Paris green as a remedy for the Colorado potato beetle was made through the migrations of this insect, the ravages of the cottony cushion scale (*Icerya purchasi*) of the orange orchards of California led to experiments conducted by Mr. D. W. Coquillett, of the United States Department of Agriculture, in 1886, to the finding of hydrocyanic-acid gas as the best medium for extirpation of scale insects (q.v.), and to its general use in fumigation for all insects which can be treated with it. In 1895 Messrs. A. F. Woods and P. H. Dorsett, also of the Department of Agriculture, began experiments which led to the adoption of a perfected system of fumigation with the same gas of plants grown under glass and injured by scale and other insects.

Our best remedies for insects, then, arsenical mixtures and kerosene emulsion and other preparations, and hydrocyanic-acid gas, are the product of American research. The bisulphid of carbon as an insecticide, however, though the discovery of a foreigner, has doubtless received greater attention in our country than elsewhere. It was first employed by M. Doyere, as early as 1856, as a remedy for weevils in stored grain, which is still its principal use; but its cost when first employed was so excessive as to preclude its general employment on a large scale. Subsequently a high grade of this chemical, known as «fuma-bisulphid,» was made for sale at 10 cents a pound. It supplements the use of hydrocyanic-acid gas in that the former is used for the fumigation of plants above ground, while the latter destroys insects affecting the root-system. Both gases are used for the treatment of indoor insects in granaries and mills, and in dwellings and ware-houses. Although these are the main insecticides there are others, nearly all of which owe their discovery and perfection to economic workers in America. They include pyrethrum, better known as Buhach, Persian, and Dalmatian insect-powders, the extensive use of which has resulted in the establishment of a considerable industry in the growing of the principal plants which produce these powders (*Pyrethrum cinerariæfolium* and *Pyrethrum roseum*); and whale-oil and fish-oil soaps, originally used against the hop-plant louse in 1886, and later against scale-insects. In more recent years what is now termed the «lime, sulphur, and salt wash» has been found a very valuable remedy against scale-insects.

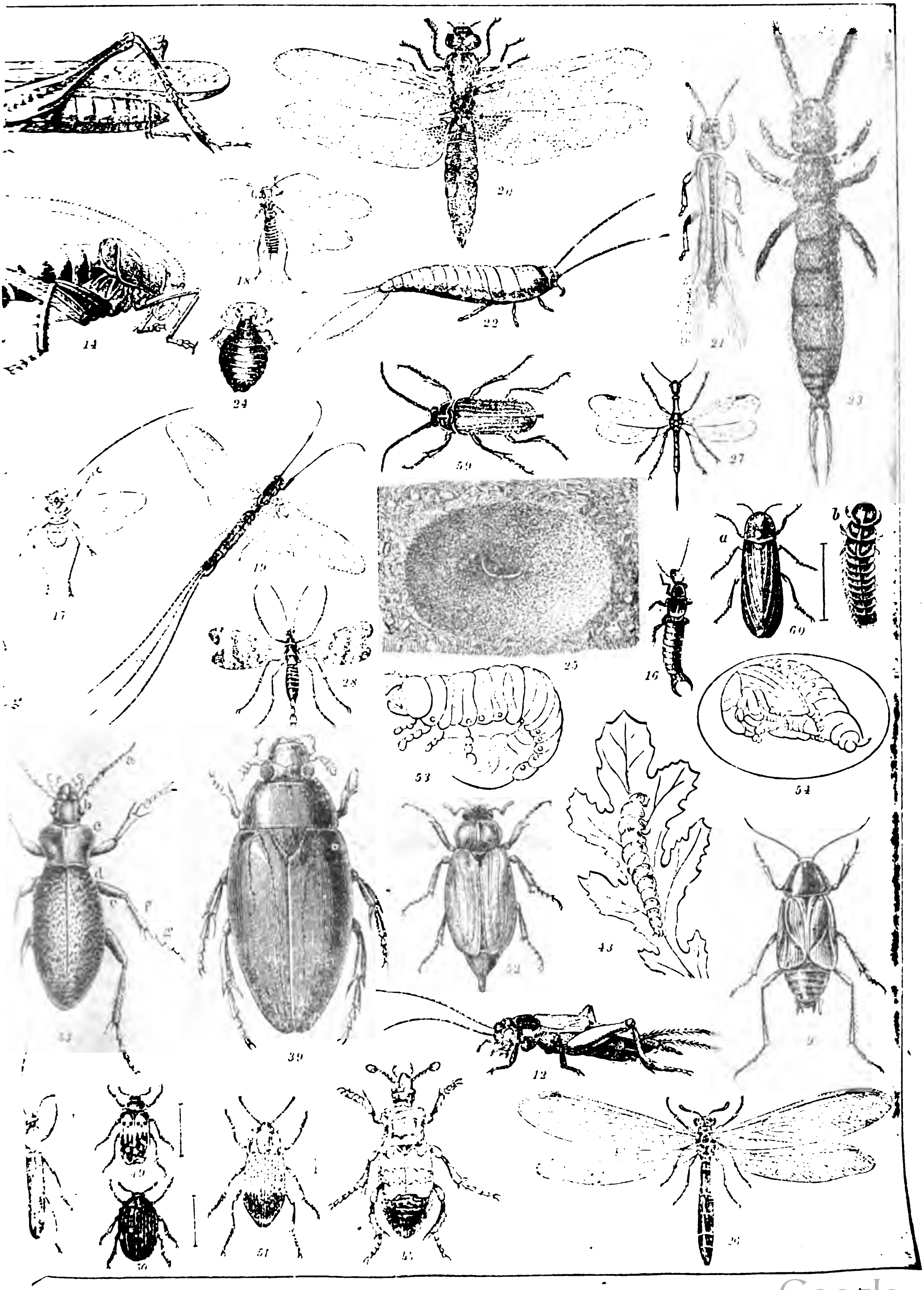
During the early years of work in spraying for various insects the principal dependence was placed in American insecticide machinery, but after the invention of different forms of nozzles by M. Vermorel, of France, various other nozzles, pumps, and other machinery were invented in America and have gone into general use.

Prevention of Insect Injuries by Farming Methods.— It would be difficult to detail step by step the wonderful progress that has been made in means of subduing insects by simple farming methods which, as a rule, necessitate little or no extra labor or monetary outlay. Some of our principal pests, with which we cannot cope successfully by means of insecticides or by mechanical methods, may be controlled by the judicious use of ordinary methods of tillage. The seed, nursery, or other stock for planting should be selected with a special view to securing immunity from attack by the insect most feared or most prevalent in the region where the crop is to be planted. By planting different immune varieties of wheat the ravages of the Hessian fly are reduced to a minimum. Certain forms of trees may be selected for planting for shade in some regions without danger of injury, because the insects which elsewhere do greatest damage to them are not present. The selection of a suitable location on the farm for a crop should be made with the same end in view. Where injury is feared by an insect which does not travel freely, immunity can be secured by planting in that part of the farm where the insect is known not to exist. The prompt destruction of crop remnants, and the pulling up and burning over of weeds and other rubbish, is a preventive applicable to all crops. Another measure is the use of «trap crops.» Thus part of an old crop may be left to attract insects which usually remain in the field after the crop is made; similar or more attractive plants may be grown for the protection of the main crop; or of early varieties of the same plants, as lures for the insects until the main crop can obtain a good start. Trap crops are of considerable value in the treatment of several of the worst enemies of cucumbers, melons, squashes, and similar vines. The stimulation of a plant by means of fertilizers, and the maintenance of healthy, vigorous growth by cultivation, the suppression of diseases, and the prevention of injury by insect pests other than those which it is specially designed to circumvent, are helpful aids. Crop rotation, or the planting of alternate crops which are not injured by those insects which ravage the staples assists in the warfare; as also do fall and spring plowing, which, in proper



Figs. 1—8 Termites. 9 Cockroach. 10 Mantis. 11 Leaf Insect. 12 Cricket. 13 Mole-Cricket. 14 Grasshopper. 15 M
23 Glacier-Flea. 24 Bird-Tick. 25, 26 Ant Lion. 27 Inocellia. 28 Scorpion-Fly. 29 May-Fly. 30 Xenos. 31, 32 Coleo
39 Hydrophilus. 40 Rove -Beetle. 41 Claviger. 42 Hister. 43 Larva of Carrion-Beetle. 44 Burying-Beetl
52, 53, 55 Dung-Beetle. 54 Cockchafer, Larva and Pupa. 56 Chalcophora. 57 Agriotes Seget

—I INSECTS.



ratory Locust. 16 Earwig. 17 Psocus. 18 Perla Bicaudata. 19 Ephemera. 20 Dragon-Fly. 21 Thrips. 22 Fishscale.
tera. 33 Carabus Coriaceus. 34, 35 Carabus Auratus and Larva. 36 Tiger-Beetle. 37 Great Water-Beetle. 38 Whirlwig.
45 Scaphidium. 46 Nitidula. 47 Colydium. 48 Cucuius. 49 Dermestes. 50 Pill-Beetle. 51 Ground-Beetle.
58, 59 Cebrion. 60 Glow-Worm. 61 Clerus Formicarius. 62—66 Death-Watch and Larva.

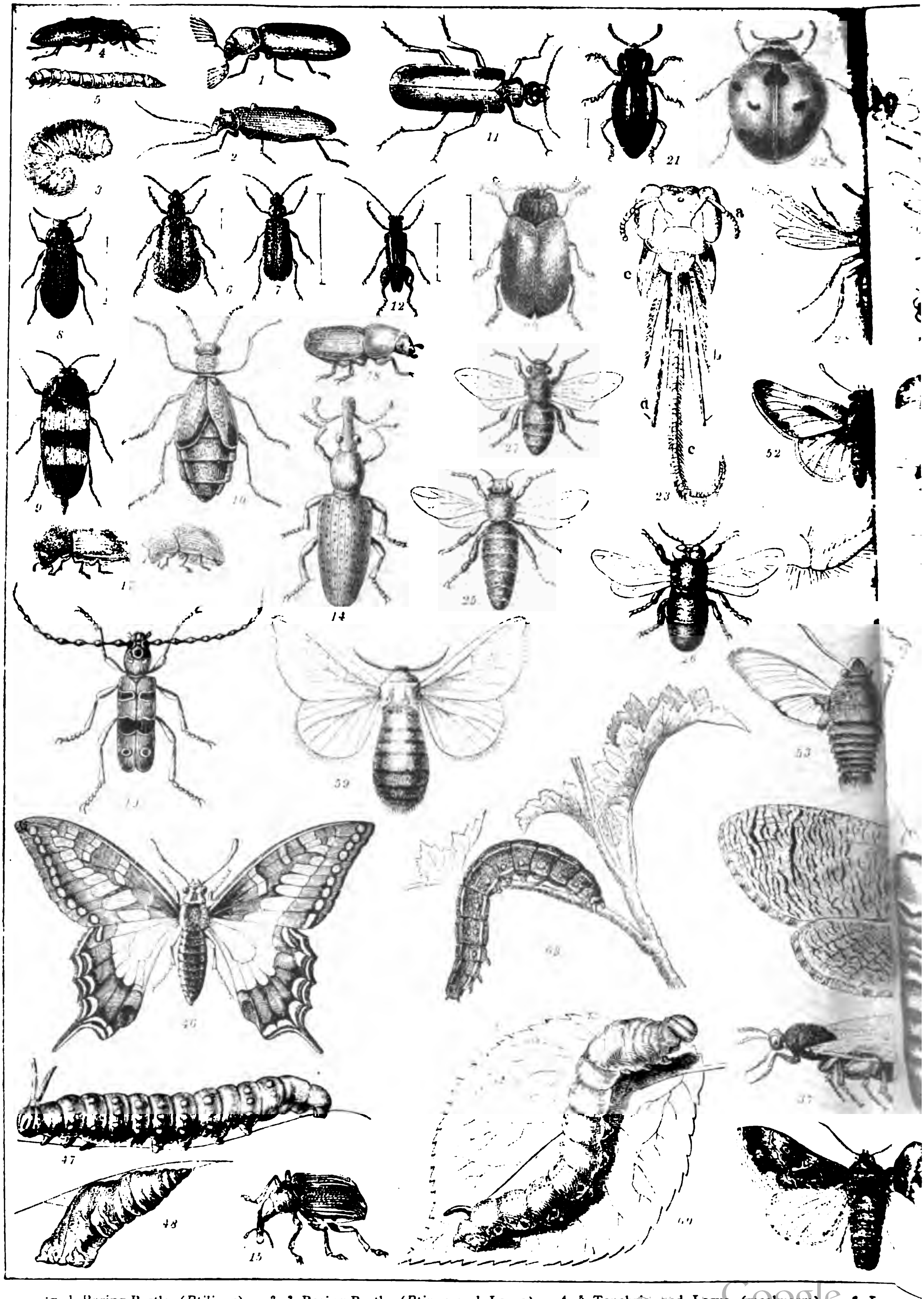
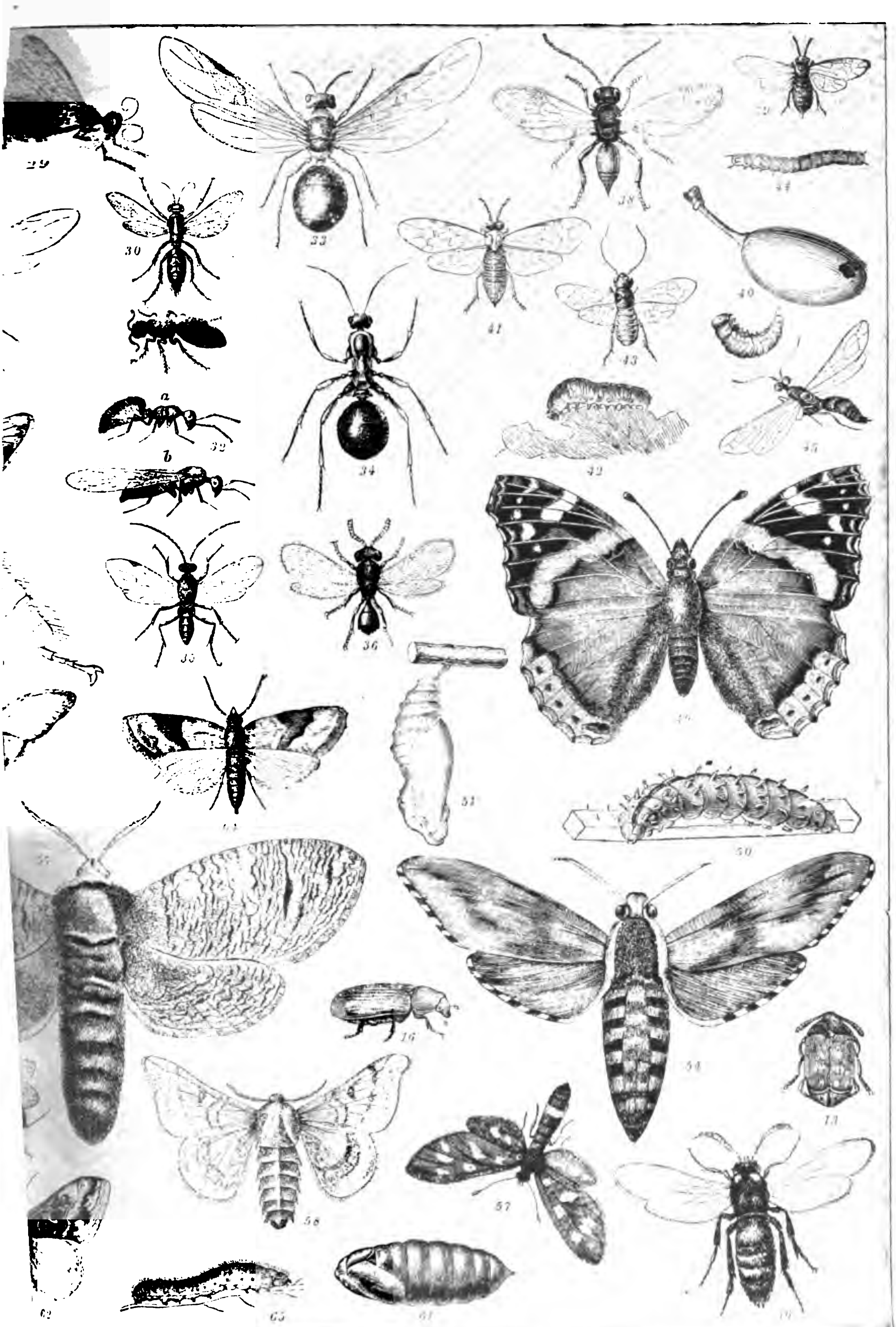


Fig. 1 Boring-Beetle (*Ptilinus*). 2, 3 Boring-Beetle (*Ptinus* and Larva). 4, 5 Tenebrio and Larva (mealworm). 6 Las
12 Oedemera. 13 Pea-Beetle. 14 Corn-Weevil. 15 Vine-Weevil. 16 Clover-Weevil. 17 Bostrychus. 18 Plum-t
24 Hindleg of Worker. 25, 26, 27 Queen, Drone, and Worker. 28 Wasp. 29 Sand-Wasp. 30 Pompilus Viat
of Brown Ant. 35 Microgaster. 36 Teleas. 37 Brilliant Ichneumon. 38 Rhodites Rosæ. 39, 40 P
45 Corn Saw-fly. 46, 47, 48 Swallow-tail Butterfly, Larva, and Pupa. 49, 50, 51 Admiral Butterfly
56 Bee-Moth. 57 Syntomis. 58, 59, 60, 61 Silkworm Moth—Male, Female, Caterpillar, and Chry



pria. 7 Scarlet-Beetle. 8 Melandry. 9 Mordella Fasciata. 10 Meloe (Oil Beetle). 11 Cantharis (Spanish Fly).
ree Beetle. 19 Alpine Goat-Beetle. 20 Lina Populi. 21 Fungus-Beetle. 22 Lady-bird. 23 Head of Bee.
icus. 31 European Mutilla. 32 *a*, Female Worker; *b*, Male of Yellow Ant. 33, 34 Female and Worker
lum tree Saw-fly and Larva. 41, 42 Turnip Saw-fly and Larva. 43, 44 Pear-tree Fly and Larva.
with Larva and Pupa. 52 Hesperia. 53 Hawk-Moth. 54 Pine Hawk-Moth. 55 Willow-Moth.
nalis. 62 Ypsilon. 63 Caterpillar of Cabbage Butterfly. 64, 65 Vine-Roller and Caterpillar.

combination, result in the destruction of nearly all forms of the many insects which pass one or more stages in the earth in hibernation. The use of water by irrigation or submersion, if practised at the right time, will result in the temporary extirpation of nearly all insects in the fields thus treated, particularly in cranberry bogs. The reclamation by drainage of land subject to more or less complete submersion, such as swampy tracts, river bottoms, and the like, and the destruction of the weeds and other plants and the insect life which remain by burning over, are of great value in suppressing many pests. If, to the methods above outlined, we add the strict observance of timely harvesting of crops with a view to the prevention of further attack and the destruction of insects which might reproduce the following year; the utilization of natural enemies, such as parasitic and predaceous insects, poultry, and live stock, to destroy the insects in the field after the crop is off; the systematic inspection of the farm for the first appearance of insect attack, and, finally, the co-operation of neighboring farmers, there is comparatively little use for insecticides save in the case of insects such as grasshoppers and the caterpillars of moths and butterflies, which are strong fliers and cannot be successfully controlled by mechanical methods.

Economic Entomologists.— Dr. T. W. Harris is credited with having been the first economic entomologist of this country, but in reality the honor is due to W. D. Peck, who began writing on injurious insects late in the 18th century (1795–1819). His writings, however, are few, in comparison to those of Harris, whose labors began in 1831 and whose greatest work appeared in 1841, his classic treatise on 'Insects Injurious to Vegetation.' In the year 1853 the New York State legislature appropriated $1,000 for the study of economic entomology, and Dr. Asa Fitch was appointed to perform the work specified. Fitch's work continued until 1871 or 1872, when his 14th and last report was published. Afterward different States, Illinois in 1866–7, and Missouri about a year later, appointed State entomologists, the latter State obtaining the services of Dr. C. V. Riley, who wrote a series of nine reports which, for originality, scientific accuracy, and practical value, have received recognition the world over.

When Dr. Riley assumed the duties of entomologist of the United States Department of Agriculture, economic entomology received a new impetus, his work and that of his assistants marking a new era in practical entomological work. Upon his death in 1894, he was succeeded by Dr. L. O. Howard, under whose direction the Division of Entomology continues to issue reports, bulletins, and circulars of the highest practical and scientific value. See AGRICULTURE, DEPARTMENT OF.

Prior to 1888 Massachusetts, New York, Illinois, and Missouri, were the only States which maintained officially appointed economic entomologists. During that year the State Agricultural Experiment Stations (q.v.) were organized under the Hatch Act, and several official entomologists were appointed in connection with them. In 1889 was formed an Association of Economic Entomologists which held annual meetings in various cities subsequently and had in 1903 a total membership of 167. A list of the addresses of the presidents at each meeting is appended. Together they form a history of the progress of applied entomology in America.

1890. Champaign, Ill., 'The Outlook of Applied Entomology,' C. V. Riley.

1891. Washington, 'Economic Entomology,' James Fletcher.

1892. Rochester, N. Y., 'Work of the Year in Economic Entomology,' S. A. Forbes.

1893. Madison, Wis., 'The Drift and Balance of Our Progress for the Year,' S. A. Forbes.

1894. Brooklyn, 'A Brief Account of the Rise and Present Condition of Applied Economic Entomology,' L. O. Howard.

1895. Springfield, Mass., 'Entomological Notes and Problems,' J. B. Smith.

1896. Buffalo, 'The Evolution of Economic Entomology,' C. H. Fernald.

1897. Detroit, 'The Present and Future of Applied Entomology in America,' F. M. Webster.

1898. Boston, 'The Duty of Economic Entomology,' H. Osborn.

1899. Columbus, Ohio, 'The *Laissez-faire* Philosophy Applied to the Insect Problem,' C. L. Marlatt.

1900. New York, 'Objects of the Association of Economic Entomology,' C. P. Gillette.

1901. Denver, Colo., 'Life History Studies on the Codling Moth,' C. P. Gillette.

1902. Pittsburg, Pa., 'On the Study of Forest Entomology in America,' A. D. Hopkins.

1902. Washington, 'The Literature of American Entomology,' E. P. Felt.

Bibliography.— Harris, 'Insects Injurious to Vegetation,' (Flint Ed., 1852); Treat, 'Injurious Insects of the Farm and Garden' (1882); Saunders, 'Insects Injurious to Fruits' (1883); Cooke, 'Injurious Insects of the Orchard, Vineyard, etc.' (Sacramento, 1883); Smith, 'Economic Entomology' (1896); Weed, 'Insects and Insecticides' (Hanover, N. H., 1891); Sanderson, 'Insects Injurious to Staple Crops' (1902); Marlatt, 'A Brief Historical Survey of the Science of Entomology, etc.' (Proc. Ent. Soc. Washington, Vol. IV., 1898); Howard, 'Progress in Economic Entomology in the United States' (Year-book, U. S. Dept. Agriculture, 1899). Also the serial publications of the United States Department of Agriculture, and of the entomologists of the State agricultural experiment stations, and of State entomologists, especially Fitch, Riley, Forbes, and Lintner.

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Entomos'traca, one of the two great subclasses of crustacea (the other is Malacostraca) including minute forms, the «water-fleas,» having a horny shell of many pieces, a well-developed cephalo-thorax, mandibles, and three pairs of maxillæ, five pairs of thoracic feet, but no abdominal feet, and no gills, breathing instead by specialized organs. They have a great variety of shapes and of means of locomotion. The young is a nauplius and develops by numerous molts. The group includes many thousands of species divided into four orders,— *Phyllopoda*, *Ostracoda*, *Copepoda*, and *Cirripedia* (barnacles). They abound in stagnant fresh waters, and also in the sea, and furnish an immense quantity of subsistence for fishes that are used for human food. They exist and increase in innumerable millions. The descendants of a single cyclops may in one year number over 4,000,000,000. At one time they render the surface of the sea-water phosphorescent by their vast luminous congregations. At another time the Atlantic Ocean is colored red over a space of hundreds of square miles by the assemblage of these minute creatures, attracting multitudes of fishes, even of whales, which feed upon them. On the other hand, some forms are equally injurious as parasites. These belong chiefly to the copepod group, *Siphonostomata,* having mouths fitted for suction. Some are commensal, entering the gill-sac or the digestive cavity and feeding upon the food, not upon the tissue of the host. Some attach themselves long enough to suck the blood of their victim and then pass on; while others enter the body as permanent residents and embed themselves in the tissue. Thus they are the pests of starfish, jellyfish, worms, ascidians, fishes, and whales. See BARNACLE; COPEPODA; CRUSTACEA; FISH-LICE; OSTRACODA; PHYLLOPODA.

Entozo'a, formerly employed as the name of a subdivision of radiate animals, has passed out of use as a term of systematic classification, because it fails to indicate or signify any ideas of structure, and only hints at the habitat and occupation of great number of living creatures. Following the strict meaning of the word, entozoa, denoting «animals within» other animals, not only brings together many genera that belong with the different subdivisions of the same general division, but also imports those which are included under classes morphologically distinct. Even this use of the term is liable to confusion, as it excludes many kinds of parasites which attach themselves to other animals, living upon their juices and tissue, without entering the cavities of the body. Of such are the whole troupe of mites which embed themselves within the skins of their hosts. (See EPIZOA.) The common bot-fly, *Gastrophilus equi,* is taken in at hatching time with the food of the horse, and, passing the larval stage of nine months in the stomach of the host, is discharged, to enter upon the adult stage, unless meantime the horse dies as the result of the great number of the guests. The degraded barnacle, *Peltogaster paguri,* attaches itself permanently to the exposed abdomen of the hermit-crab, deriving its sustenance from the host, but feeding upon rather than within the body of its victim.

The present use of the term entozoa is artificial, and tends to restrict its application (following Cuvier in this respect, though for convenience only) to that section of the class *Vermes,* known as platyhelminths or anneloids, a group of lower grade than the true worms, or annelids. All parasitic animals are degraded in structure because the field and manner of their life makes no demand upon higher and more specialized organs. In the class *Platyhelminth,* embracing the following described forms, are the planarians which are not parasitic, and the flukes and tapeworms, which are both parasitic and injurious. The difference between the former and the two latter illustrates one of the most interesting facts in biology. The planarians, leading a free and non-sessile life, are provided with sense-organs and organs of locomotion and defense which equip them for the exigencies of an active, competitive life; the parasites, on the contrary, are destitute of any such outfit or of any effective tools, save hooks or suckers for holding their anchorage, and the simplest instruments for boring into and for eating their hosts. In the free stage of life they abound in fresh water or salt, and in moist conditions. Of the sub-class *Trematoda* are the flukes, very large in numbers, which pass through most interesting changes in development, their habitat and organs varying with each successive stage. The larva, after leaving the egg, swims freely, enters the body of its host, changes form, and becomes the parent of a number of the second generation; these may remain until they mature, or in some species they may, during the progress of their metamorphoses, infest three different hosts. During these transitions the larva enjoys a commensal existence, feeding on the food swallowed by the host; but having reached the adult stage it lives by destroying the tissue in which it is moored. *Distomum hepaticum* or liver-fluke, which is found in fresh water, is a case in point. Its life moves in a circle. As an adult it inhabits the liver of mammals. The eggs there produced are discharged through the intestines into the outer moisture, where they hatch. The larva takes to the water and swims until it attacks a particular snail, *Lymæus trunculatus,* into which it enters; assumes the form of a sac or cyst, which soon produces a tadpole; the snail crawls out among the grass, and leaves this cercaria, which shakes off its tail and becomes encysted on a spear of grass. Finally, a sheep eats the grass, the cyst is dissolved, and the adult worm, three quarters of an inch long, buries itself in the sheep's liver. It is found in the liver of many ruminants and of other animals, including man. Many trematods abound in the sea, infesting cuttlefish and cephalopods. *Cestoda* is the sub-class of tapeworms, which infest and work destruction in nearly all vertebrate animals. The form is elongate and flat, like a ribbon or tape, and the tapeworm is divided into sections — proglottids — forming a chain. Their manner of life has resulted in almost complete organic degeneration, as they have neither organs of locomotion nor a digestive canal, merely absorbing the juices of the host through the pores of their skin. There are two types: *Ligula,* having only a partially divided body; and *Tænia,* completely jointed, and each joint containing eggs for reproduction. The head is small, about the size of a pin, and is crowned with a ring of about 25 hooks, by which the worm anchors in the walls of its host's intestine. See TAPEWORM.

In the case of *Tænia solium* the larva must be twice swallowed, each time by a separate host. A pig takes in the egg mixed with its food. A cyst or cysticercus is formed and enters the tissue, producing «measly pork,» which may be eaten by human beings, transferring the cysticercus to an attachment in the alimentary canal of the new host. In *Tænia echinococcus* the reverse process holds. The larval stage is passed within a human or other animal, while the adult appears in the dog or some other domestic animal. This parasite sadly afflicts the Icelanders, and appears to result from their uncleanly habits and from the large number of their dogs, these latter communicating the pests to plants gathered for food. Other species of *Tænia* are parasitic in dogs and sheep, promot-

ENTOMOLOGY, MYRIAPO

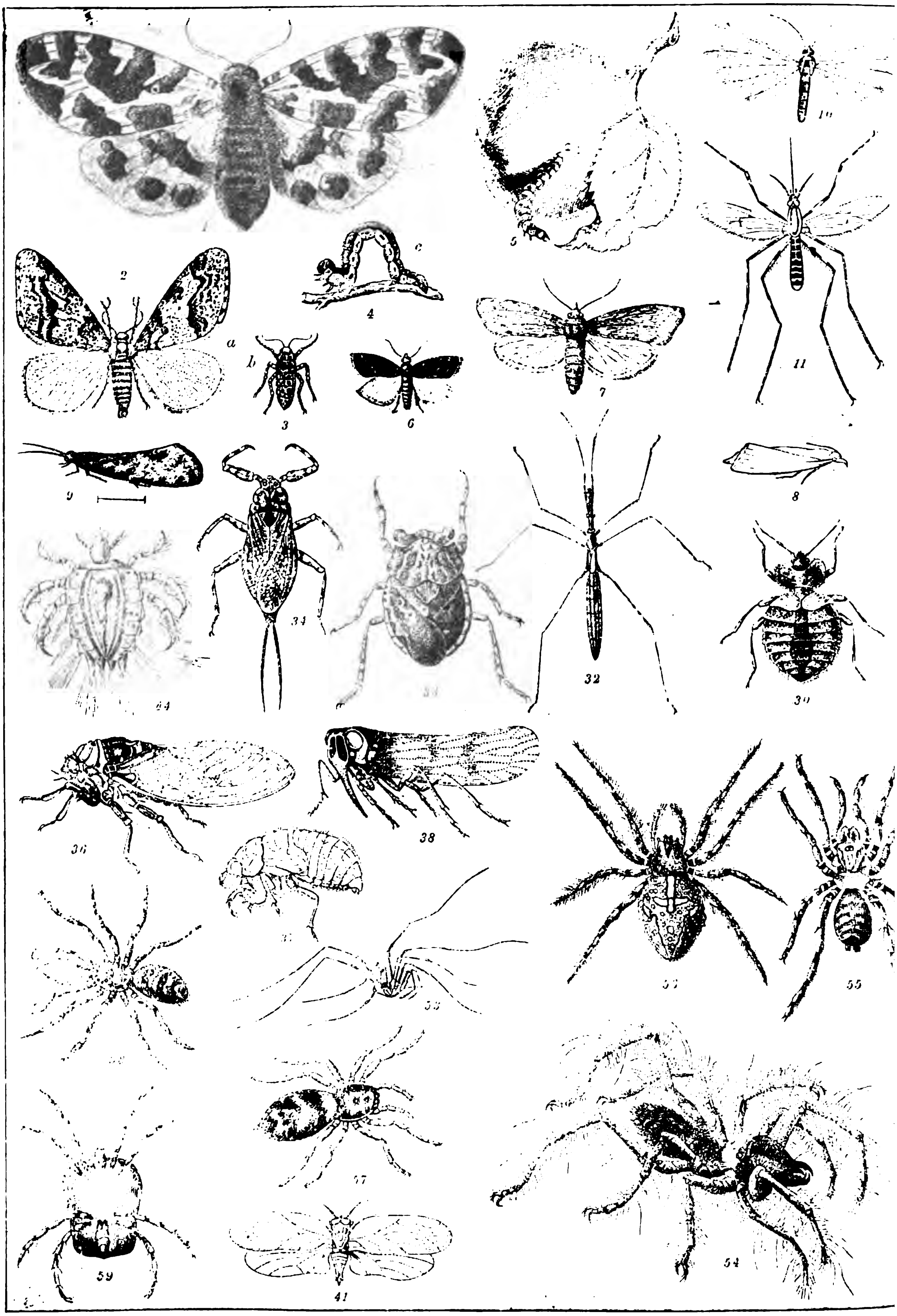
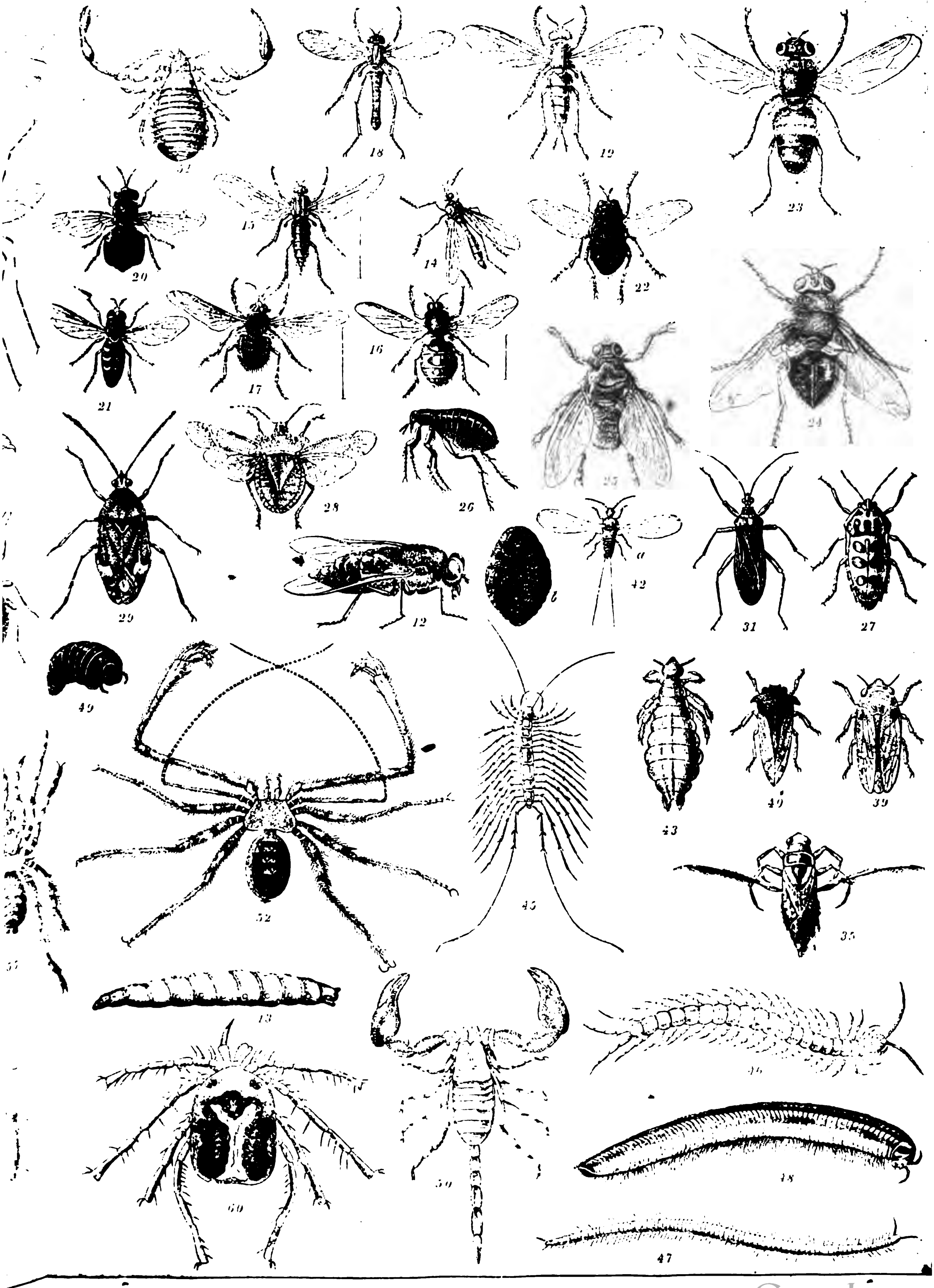


Fig. 1 Tiger-Moth. 2, 3, 4 Winter-Moth. Male, Female, Caterpillar. 5, 6 Apple-Roller. 7, 8 Honey-Moth. 9 Clothes-M
17 Bombylius. 18 Vermileo. 19 Volucella. 20 Stratiomys. 21 Syrphus. 22 Tachina. 23 Bot-Fly. 24 Blue-B
32 Water-Flea. 33 Bank-Scorpion. 34 Water-Scorpion. 35 Water-boatman. 36, 37 Cicada and Larva. 3
b, Female. 43 Louse. 44 Crab-Louse. 45 Scutigera. 46 Scolopendra 47 Millepede. 48 C
54 Scorpion-Spider. 55 Mining-Spider. 56 Garden-Spider.



th. 10 White-plume Moth. 11 Ringed Gnat. 12, 13 Breeze-Fly and Larva. 14 Hawk-Fly. 15 Leptis. 16 Anthrax.
ttle. 25 Forest-Fly. 26 Flea. 27 Beetle-Bug. 28 Wood-Bug. 29 Phytocoris. 30 Common Bug. 31 Reduvius.
Burrowing Cicada. 39 Frog-hopper. 40 Centrotus Cornutus. 41 Psylla Genistæ. 42 Cochineal, *a*, Male,
entipede. 49 Pill-Worm. 50 Scorpion. 51 Book-Scorpion. 52 Tarantula. 53 Weaving-Spider.
ider. 57, 58 Hunting-Spider. 59 Scarlet-Mite. 60 Water-Mite.

ing in the latter the disease commonly called «staggers.» The largest specimens of the cestod group belong to the family *Bothrioeephalidæ*, which hold their mooring by two suckers on the head. The length of these worms sometimes reaches 30 feet.

The filiform, or threadworms, belong to the division *Nematoda*. *Filaria sanguinis-hominis* is referred to as the cause of elephantiasis; a disease common in Oriental tropical climes. The disease is said to be spread by the mediation of mosquitoes, which suck in the larvæ with the blood of the patient whom they bite. Then, when depositing their own eggs in the water, they die, setting free the threadworm embryos, the progeny of which are transferred to the human system through drinking the water. The nematoid trichina is the most dangerous of human parasites, finding its way into the body through the eating of pork, the larvæ having been developed in swine. After the meat has been swallowed the cyst containing the larva is dissolved in the digestive process; the larva is released, becomes mature, reproduces in multitudes of young, which make their way into the muscular tissue, where again they mature and may remain for years. Thorough cooking kills the larvæ in the pork. (See TRICHINA SPIRALIS.) Allied to trichinæ is *Trichocephalus dispar*, which is sometimes found in the human colon. Some genera of *Strongyllidæ* attack the human body, but other genera are the despair of poultry-raisers. *Syngamus trachealis* enters the respiratory passages of fowls, and produces the «gapes.» The afflicted bird, by coughing, expels the eggs of the parasite, which mingle with food and are eaten by other fowls, and the disease becomes epizootic. On the first discovery of the infection the afflicted subject should be isolated. *Ascares* is the nematoid known as the pinworm, and is a human entozoon of universal distribution. The eggs, being light, are easily distributed. In the human system they develop to the adult form. Happily this pest, and all others of the entozoan kind, rapidly diminish as public and domestic cleanliness, sewerage, and sanitary plumbing increase. The class *Anthrocephali* or spine-headed worms, enter pigs, fishes, and other animals as intestinal guests, and are said sometimes to afflict man. The proboscis is armed with barbs, like those of the tapeworm, by which the guest fastens itself in the tissues. The larval stage is supposed to be passed in the body of some aquatic animal. See also PARASITES.

Entre-Douro-E-Minho, ĕn'trĕ dō'roo ē mēn'yoo, a province of Portugal, more generally known by the shorter appellation of Minho. Pop. about 1,175,000.

Entre Rios, ĕn'trā rē'ōs, Argentine republic, a province bounded on the north by Corrientes, on the east by the republic of Uruguay, on the south and west by the provinces of Buenos Ayres and Santa Fé. As its name indicates, its territory lies «between the rivers»— Rio Paraná and Rio Uruguay. Area 45,000 square miles. Agriculture and immigration have been encouraged by the provincial government, which sells land to settlers in portions of 82½ acres, to be paid for in three years, at prices ranging from $600 to $2,000, according to location. In 1880 there were 32 agricultural colonies; in 1885 there were 54; 122 in 1891, and so on. The cultivated area in 1887 was 248,411 acres; in 1891 it had increased to 855,000 acres. This increase is noticeable especially in the area devoted to wheat, the quality of that product being uncommonly good. Other products are: Maize, lucerne, barley, flax, grapes, tobacco, fruit, and (on a very large scale) cattle, sheep, and horses. Its capital, the city of Paraná (population 20,000), was the capital of the republic from 1852 to 1861; it has a national college, a normal school, and several elementary schools, and is an important port for the traffic on the Paraná River. Population of the province more than 300,000.

Entrecasteaux, Joseph Antoine Bruni d', zhō zĕf äṅ twän brü nē dŏṅtr-käs-tō, French navigator: b. Aix 1739; d. at sea near the island of Waigeoo 20 July 1793. He entered the naval service in 1754, gradually rose to the position of commandant of the French fleet in the East Indies (1786), and in 1787 became governor of Mauritius and the Isle of Bourbon. In 1791 he was sent by the French government in search of La Pérouse, who had not been heard from since February 1788. He failed in detecting any trace of him, but ascertained with great exactness the outlines of the east coast of New Caledonia, west and southwest coast of New Holland, Tasmania, and various other coasts. The D'Entrecasteaux Archipelago was named in his honor.

Entresol, ŏṅ tr-sŏl or ĕn'tėr-sŏl (Fr. «between the floors»), a low story between two of greater height, generally the ground and first stories. It is called also the Mezzanine.

Entro'pion, or **Entropium**, inversion or turning in of the edge of the eyelids, in consequence of which the lashes rub on the eyeball, causing annoyance and pain.

En'tropy, in thermodynamics, a certain mathematical expression whose value does not change when the substance under discussion undergoes a reversible compression or expansion, while not receiving any heat from external sources, nor giving any up to them. In general, the change of entropy that a body experiences when it passes from one state to another by a reversible process, is found by dividing the heat that the body absorbs during every infinitesimal part of the process of transformation by the absolute temperature of the body at the corresponding instant, and integrating the results. The term entropy does not appear to admit of any simpler explanation than has here been given; and, in fact, while the conception of entropy (which we owe to Clausius) is a valuable and almost indispensable aid in advanced thermodynamics, it has always proved a stumbling-block to the beginner. The entropy of a body, unlike its temperature, cannot be obtained by direct observation, but must always be inferred by the process given above, or by some graphical method equivalent to it. The transformation that a body undergoes when its entropy does not change at all is called an «adiabatic» or «isentropic» change. See THERMODYNAMICS.

Entry, Right of, the right of taking possession of lands or property by entering or setting foot on the same. This may be done either by the claimant personally, or through his agent or attorney.

Entry, Writ of, a formal declaration made by one exercising the right of entry in recovering property of which he has been disseized that he claims full possession of the said property. The common law action of Writ of Entry has some time been obsolete.

Ent'wistle, James, American naval officer: b. Paterson, N. J., 1837. He entered the engineering service United States navy 1861, became commander in 1888, and in 1899 was made captain and rear-admiral and was placed upon the retired list. He first served on the Aroostook under Farragut in the Western Gulf squadron, and on 21 other vessels, was inspector of machinery at the Bath (Maine) Iron Works 1890–5, while the ram Katahdin and the gun-boats Machias and Castine were in process of construction, and assistant to the general inspector at Mare Island Navy Yard in 1895. He joined the Asiatic squadron at Yokohama during that year, being appointed fleet engineer 1897 and assigned to the Olympia. He took part in the battle of Manila Bay, 1 May 1898, being advanced in numbers for meritorious services upon that occasion. He died 23 March 1910.

Envelope, a paper case, sealable by means of an adhesive flap, and used for enclosing letters or other matter. Envelopes were not in general use in any country prior to 1840, when, after the passage of the penny postage bill, they became common in England. Until about 1845 nearly all letters in this country were folded so that an unwritten portion came on the outside, and the address was placed there. By that time envelopes were well known, and by 1850 all letters were enclosed in them. The first maker of envelopes in New York was an Englishman named Dangerfield, who began about 1846; and by 1850 Alderton and several others were in the field. Only 2,000 or 3,000 could be made in a day, as machinery had not yet been employed. The blanks were cut out by chisels and pasted and folded by hand. Machines were invented in England in 1845 by Warren de la Rue and Edwin Hill, but these were never employed in America. The machinery employed for this purpose in the United States was invented here, but not until just before the outbreak of the Civil War. Many improvements have been made, and the speed is now so great that on some of the machines the output will reach 55,000 a day. It is supposed that the consumption of envelopes in this country is from 8,000,000 to 10,000,000 a day, or not far from 3,000,000,000 a year, of which 600,000,000 are stamped envelopes. The latter are all supplied by the Morgan Envelope Company, of Springfield, Mass., and the Plimpton Manufacturing Company, of Hartford, Conn. There are about 30 large firms engaged in the business, besides a number of smaller manufacturers. The principal towns thus employed are New York, Philadelphia, Hartford, Rockville, Holyoke, Worcester, and Springfield.

Envir'onment, a modern scientific term applied to the modifying influences of an organism or surroundings. Neither plant nor animal can be understood as a rounded-off unity; the whole life or function is made up of action and reaction between the organism and its environment. Streams of matter and energy from without preserve the relative constancy of the organism, as of a special wave-crest in the sea; while changes in the streams have their corresponding changes within the organism. The plant or animal has obviously a strong unity of its own, but even that is in part due to ancestral welding under the hammers of the environment. It may seem, too, to vary of itself like a fountain in the air, but throughout all its rises and falls there blows the wind of the environment.

The influence of outside conditions has been recognized by most naturalists from the time of Hippocrates, and is taken for granted in our everyday speech and action. There is considerable difference of opinion, however, as to the importance and degree of this influence. Thus Buffon, Treviranus, and Geoffroy St. Hilaire regarded the surroundings as directly hammering changes on the organism; while to Erasmus, Darwin and Lamarck internal changes arose as indirect functional results of new environment. Charles Darwin allowed a measure of truth in both these positions, but emphasized the independent action of the organism itself in the direction of natural selection. These three positions are still held, some emphasizing one, others another, the majority combining the three. See DARWINIAN THEORY; EVOLUTION.

Envoy, a person deputed by a sovereign or government to negotiate a treaty, or transact other business, with a foreign ruler or government. We usually apply the word to a public minister sent on a special occasion or for one particular purpose; hence an envoy is distinguished from an ambassador. Envoy extraordinary and minister plenipotentiary is a permanent resident abroad, in some unimportant country officially representing his government, but of inferior rank to an ambassador.

Enzina, Juan de la. See ENCINA, JUAN DEL.

En'zyme (Gr. "leavened"), any of the unorganized ferments, such as diastase, cytase, trypsin, etc., which induce fermentive changes in organic substances. It was formerly thought that these "unorganized" ferments might be essentially different in their action from the so-called "organized" ferments, such as the yeasts, molds, and bacteria; but it is now known that the fermentive action of the "organized" class is due chiefly, and perhaps wholly, to the enzymes that they secrete. The chemistry of the enzymes is very imperfectly understood. According to some authorities they act merely by catalysis, being capable of effecting the fermentive change of indefinite quantities of the substances upon which they act, without being themselves used up, nor exhausted in any way. According to other authorities, they are gradually destroyed by their own activity, so that a definite mass of any given enzyme can produce only a definite (though surprisingly large) amount of fermentive transformation. See FERMENTATION.

Chemical ferments, elaborated in the cells of plants and animals, and capable of bringing about a peculiar series of biochemical reactions, which are produced without the intervention of physical factors or mineral substances. Under some conditions they have the properties of facilitating chemical interchanges between certain bodies without entering into the composition of the different products that result.

These enzymes, or ferments, zymases, or diastases, as they are frequently called, play an important role in the digestive processes, as well as being of vital importance in the general life-history of nearly all plants. A knowledge of enzymes dates back to very remote periods. In the beginning of the 16th century observations on the phenomena of digestion called attention to this class of bodies; but it remained for Dubrunfaut and Pasteur to place the science of fermentation on a stable basis. Enzymes are for the most part soluble in water, being thrown out of solution by a large number of chemical substances, such as alcohol, tannic acid, etc. They usually lose their activity at a temperature above 100° F. Most of them decompose hydrogen peroxide, and they act largely in proportion to their quantity. With reference to their chemical composition, it would appear that they belong to the proteid class. There is usually a large proportion of inorganic salts, particularly calcium phosphate, in their composition. A few, however, do not contain nitrogen. Although closely related to proteids, they do not give proteid color-reactions. As to their formation, it is considered by some that they are oxidation products of albuminoid substances, or zymogens. The transition of the zymogen into the ferment is termed zymogenesis. Destruction of enzymes is termed zymolysis. As to the manner of action of this interesting class of bodies, a vast variety of phenomena may be observed. They may bring about molecular changes either by hydration or by oxidation. They appear to occupy the position of intermediaries, as it were. Many thories are put forward in attempting to explain the action of enzymes; but as they present many analogies to living protoplasm, explanation of the phenomena of their activities is almost as difficult as to explain the phenomena of life. Attempts have been made to classify the various enzymes, but any classification must be of a transitory character, since knowledge concerning this group of bodies is increasing daily. The classification of the soluble ferments suggested by Effront is shown below.

The enzymes have many applications in the arts. Consult: Greene, 'Soluble Ferments'; Effront, 'Enzymes and Their Applications,' John Wiley, N. Y., 1902.

Eocene (ē'ō-sēn) **Epoch** (Gr. «dawn»), a term applied in geology to one of the divisions of the Tertiary, as originally suggested by Lyell; a geological period. See EOCENE SERIES; TERTIARY.

Eocene Series, a subdivision of geological time. Lyell in 1833 first used the term Eocene (dawn of the recent) for the earliest of his

CLASSIFICATION OF SOLUBLE FERMENTS.

Names of the Enzymes.	Substances on which the Enzymes Act.	Products of the reaction.
A. SOLUBLE HYDRATING FERMENTS.		
1. Soluble Ferments of Carbohydrates.		
Invertin or sucrase	Cane-sugar	Invert-sugar
Amylase	Starch and dextrin	Maltose
Glucase or maltase	Dextrin and maltose	Dextrose
Lactase	Lactose	Dextrose and galactose
Trehalose	Trehalose	Glucose
Inulase	Inulin	Fructose, levulose
Cytase	Cellulose	Sugars
Pectase	Pectin	Pectates and sugars
Caroubinase	Caroubin	Caroubinose
2. Soluble Ferments of Glycosides.		
Emulsin	Amygdalin and other glycosides	Glucose, oil of bitter almonds, and hydrocyanic acid.
Myrosin	Potassium myronate	Glucose and allyl isosulphocyanate
Betulase	Gaultherin	Oil of wintergreen Glucose
Rhamnase	Xanthorhamnin	Rhamnatine, isodulcite
3. Fatty Ferments of Fatty Substances.		
Steapsin Lipase	Fatty substances	Glycerin and fatty acids
4. Soluble Ferments of Proteins.		
Rennet	Caseinogen	Casein
Plasmase	(Casein, Hammarsten)	(Para casein)
Casease	Fibrinogen	Fibrin
Pepsin	Casein	
Trypsin	Albuminoid substances	Proteoses, peptones
Papain	Albuminoid substances	Proteoses, peptones, amides
5. Ferments of Urea.		
Urease	Urea	Ammonium carbonate
B. SOLUBLE OXIDIZING FERMENTS.		
Laccase	Uruschic acid Tannin, anilin, etc.	Oxyuruschic acid Products of oxidation
Oxidin	Coloring matters of cereals	Products of oxidation
Malase	Coloring matters of fruits	Products of oxidation
Olease	Olive oil	Products of oxidation
Tyrosinase	Tyrosin	Products of oxidation
Oenoxidase	Coloring matter of wine	Products of oxidation
C. FERMENTS CAUSING MOLECULAR DECOMPOSITION.		
Zymase or alcoholic diastase	Various sugars	Alcohol and carbonic acid

three subdivisions of the Tertiary. The term found favor quickly since early Tertiary life differed greatly from late cretaceous. Toward the close of cretaceous time, the sea receded from a large part of North America and by the end of Eocene time the continent had nearly its present form. Though the climate continued warm, Greenland and Alaska having a temperate climate, yet the elevation of the land must have affected the direction of prevailing winds and modified rainfall. Of cretaceous animals the reptiles suffered most, the ichthyosaurs, dinosaurs, and plesiosaurs passing away as well as many peculiar mollusks. Eocene fishes were mostly of modern character (teleosts), birds were more numerous and highly developed than in the Cretaceous Age; while mammals developed wonderfully. True carnivorous mammals (cynodictis) appeared, as also the ancestors of the horse (*Hyracotherium*), rhinoceros (*Heptodon*), tapir (*Systemodon*), pig (*Eohyns*), and the ruminants (*Trigonolestes*), besides bats, primitive camels (*Leptotragulus*), and monkeys (*Anaptomorphus*). A study of organic types indicates that Asia, North America, and Europe were connected in Eocene time and, by the Antarctic continent, South America, and Australia, while South America was separated from North America and Africa and southern Asia from Europe and northern Asia.

The Eocene formations in the United States are classified geographically as the Atlantic border, Gulf border, interior and Pacific border provinces. The Eocene rocks of the Atlantic border are nearly all loose sands and clays of marine origin and contain in New Jersey beds of greensand once of some economic importance as a source of phosphate of lime for agricultural use. The rocks of the gulf border were partly laid down in fresh or brackish water and partly in salt water. They comprise shales, sandstones, and limestones. In Florida are valuable deposits of phosphate rock, and in Texas are extensive beds of lignite, of workable size, but poor quality. The series is divided into the (1) Midway, (2) Lignitic, (3) Lower Clairborne, (4) Clairborne, (5) Jackson, and (6) Vicksburg stages. The interior province formations, mostly clays and sands, were laid down in brackish or fresh water lakes which stretched, though not contemporaneously, from Mexico to Alaska. The largest of these lakes covered eastern Utah, and western Colorado, and must have been 450 miles long and 250 miles wide. In Utah are lignite deposits of some importance. The lake deposits are divided into the (1) Puerco, (2) Wasatch, (3) Bridges, and (4) Uintah stages. In the Pacific border province the Lower Eocene stages are wanting and the epoch is represented by a single series, the Tejon, shales and sandstones with workable deposits of lignite in California and Oregon. See CENOZOIC ERA; GEOLOGY; TERTIARY SYSTEM.

Eohippus, ē-ō-hip'ŭs, a genus of fossil horses of the Eocene Epoch, with four complete toes in the fore foot and three in the hind foot, and with slender bony rudiments (splint-bones) representing the missing innermost digit in the fore foot and the outermost digit of the hind foot. The teeth are short-crowned, the premolars of simpler pattern than the true molars, and the molar cusps are incompletely converted into crests. The animal was as large as the domestic cat, and probably a direct ancestor of the horse. Its remains are found only in the Lower Eocene of North America. See HORSE, FOSSIL.

E'olus («the varied one»), in Greek mythology, god of the winds.

Eon de Beaumont, ā-ôṅ dė bō-môṅ, **Charles Geneviève Louis Auguste André Timothée d'** (called till 1777, CHEVALIER D'EON), French writer, military officer, diplomatist, and publicist: b. Tonnerre 5 Oct. 1728; d. London 21 May 1810. His brilliant qualities enabled him to act a conspicuous part in the world, but he gained a greater notoriety by the mystery long kept up in regard to his sex. In 1755 he was sent as envoy on a difficult mission to the Russian court. Here he gained the favor of the Empress Elizabeth, and for about five years was the medium of a secret correspondence between her and the king of France. In 1762 he went to London as secretary of legation and lived for years in London as a kind of informal representative of his sovereign. In 1777 he returned to France, but Louis XVI., for what reason is not known, imposed on him the obligation of assuming female attire, and he now styled himself La Chevalière d'Eon. Even before this, however, doubts as to his real sex had arisen. After the French Revolution broke out, he offered his services to the National Assembly in 1792, was rejected, and went back to England. He now attempted to support himself by giving lessons in fencing (still dressed as a woman), but was not very successful, and depended for subsistence mainly on his friends. He was rather a voluminous writer, and his works appeared in 1775 under the title ‹Loisirs du Chevalier D'Eon.›

Eos, ē'ŏs. See AURORA.

Eosinophiles, ē-ō-sĭn'ō-fīls, one of the types of leucocytes or white blood-cells found in the circulating blood and characterized by its specific reactions to acid stains, such as eosine, whence its name — «a lover of eosine.» Eosinophiles are present in the proportion of one half to two per cent of the white blood-cells. Their increase above two per cent is termed eosinophilia, and it has an important relationship to some forms of parasitism.

Eosinophil'ia, a condition in which there is an excess of eosinophile white blood-cells in the circulating blood. The exact causes of eosinophilia are not thoroughly understood. But it seems to be an almost constant accompaniment of certain diseases, notably of infection by intestinal parasites. So it is in trichiniasis, in anchylostomiasis, and in infection by the ordinary tapeworm. Consult: Ewing, ‹Pathology of Blood› (1902).

Eōthen, ē-ō'thĕn, or **Traces of Travel Brought Home from the East,** a noted work by Alexander William Kinglake, published in 1844. Eōthen — a title meaning «From the Dawn» — is a lively and acute narrative of travel in the East, at a time when that region was comparatively new ground to English tourists. The author, starting from Constantinople, visits the Troad, Cyprus, the Holy Land, Cairo, the Pyramids, and the Sphinx; thence by the way of Suez he proceeds to Gaza and returns by the way of Nablous and Damascus. He apologizes for his frankness of style, and gives his im-

pressions with refreshing directness, modified as little as possible by conventional opinion.

Eötvös, ĕt'vĕsh, **Joseph,** Hungarian statesman and author: b. Ofen 3 Sept. 1813; d. Pesth 3 Feb. 1871. He completed his studies in philosophy and law at the University of Pesth in 1831, and before leaving the university, produced three dramas — 'Kritikusok,' 'Házasulók,' and 'Boszú' — the last a tragedy, all of which were well received. He published an important work on the reform of prisons (1838); became a friend of Kossuth, and distinguished himself as a journalist and in the diet. A collection of his political writings was published in Leipsic in 1846. He continued to give his leisure to literature, and published a succession of novels — 'The Carthusian' (1841); 'The Village Notary' (A'falu' jegyzöje, which has been translated into English), 1844–6; 'Hungary in 1514' (1847–8) — giving vivid pictures of Hungarian life in modern and more remote epochs. After the revolution of 1848 he became minister of public instruction under Batthyani, but soon retired to Munich, and remained in voluntary exile for three years, during which he published several works, among which was 'The Influence of the Ideas of the 19th Century on the State of Society' (1851). About the middle of 1851 he again returned to Hungary, where he was made vice-president of the Hungarian Academy in 1855, and president in 1866. In 1867 he again became minister of public instruction.

Eötvös, Roland, Hungarian scientist and statesman: b. 27 July 1848. He is a son of Joseph Eötvös (q.v.). He studied at Konigsberg and Heidelberg, receiving an appointment as lecturer at Budapest 1871 and as professor of experimental physics there 1875, being made a member of the Hungarian Academy of Sciences 1873, and becoming its president in 1893. Much of his attention has been given to the problems of gravitation and capillary attraction. He was made a life member of the Hungarian House of Magnates and was minister of public worship and education 1894–5.

Eozoic (ē-ō-zō'ĭk) **Era** (dawn of life), the Geologic Period during which life first appeared on the earth. The eozoic rocks, though often showing traces of organic origin, have in general been greatly metamorphosed and contain few, if any, fossils. Stratigraphically they are separated from the Archæan (or Azoic) rocks below and the Cambrian (or earliest Palæozoic) rocks above by unconformities, but the exact boundaries of the Eozoic are disputed by geologists. See Algonkian System; Geology; Huronian Series; Keweenawan Series.

Eozoön, ē-ō-zō'ŏn. Sir J. W. Dawson, in 1864, described certain curious aggregates of calcite and serpentine in the Laurentian limestone of the lower St. Lawrence Valley as the remains of a foraminiferan which he called Eozoön Canadense. The so-called fossil was thought to represent the earliest known form of life on the globe. The evidence of organic origin is, however, not conclusive. Similar forms have been found in Bavaria. Moebius, who investigated Eozoön thoroughly, concluded that the serpentine in the calcite had infiltrated along a very regular system of fine fissure, and most geologists now believe that Eozoön is of inorganic origin.

Epacridaceæ, ĕp-ạ-krĭ-dā'sẹ-ē, a small order of heath-like shrubs or small trees, usually reckoned as the Australian sub-order of *Ericaceæ*, from which they are chiefly distinguished by the epipetalous stamens destitute of the peculiar specializations of anther dehiscence or appendages. The flowers are red, white, or purple, generally in leafy spikes. Many species are cultivated in greenhouses along with the heaths proper. Among the most attractive of these is *E. grandiflora*, which has blossoms nearly an inch in length, of a brilliant reddish purple at the base and pure white at the apex. A few species produce edible berries resembling the American huckleberry, and which are known as Australian cranberries.

E'pacts (Gr. «additions»), in ecclesiastical chronology, a set of 19 numbers used for fixing the date of Easter and other Church festivals, by indicating the age of the moon at the beginning of each civil year in the lunar cycle (q.v.). At the reformation of the calendar in 1582 it was found that the Golden Numbers could no longer by themselves serve the purpose of adjusting the double reckoning by lunations and by the tropical or true year; and thus, instead of adopting the more rational computation, the Roman Church devised the artificial and involved method of epacts. The main point to determine is the age of the moon (in entire days) at the beginning of each civil year, or the number of days between the end of the ecclesiastical year in December and the first January succeeding. Thus, subtracting 354 days (12 lunations) from 365, we should have 11 days for the first annual epact, then 22 for the year following, then 3, 14, 25, 6, 17, 28, 9, 20, 1, 12, 23, 4, 15, 26, 7, 18, and 29; the series of 19 numbers being obtained in succession by adding 11, and when the sum exceeds 30, subtracting that number. This illustration, however, is simpler than any actual case, by reason of the leap-years, which require 12 to be added for the following epact, and of the fact that no lunation is exactly 30 days long. When the lunar cycle of 19 years is completed, the epacts recur again in the same order. In the Anglican reckoning, as distinguished from the Roman, it is noteworthy that the Gregorian epact for any year is the same as the Julian epact for the year preceding, owing to the coincidence that 11, the number of days lost on the Julian account before the English parliament adopted the reformed calendar (q.v.), is also the number of days between the lunar and the solar years. The epact determines by subtraction the date of the first new moon in January; then by adding 29 and 30 alternately the successive new moons throughout the year are assigned to their respective dates. Consult Delambre, 'Astronomie Moderne,' Vol. I. 4–32.

Epaminondas, ē-păm"ĭn-ŏn'dăs, Theban hero: b. about 418 B.C.; d. Mantineia, Arcadia, Greece, 362 B.C. He was distinguished for the friendship subsisting between him and Pelopidas. He was sent to Sparta 371 B.C. to represent Thebes in negotiating a peace with the Athenian envoys. As the Spartans refused to recognize Thebes as the representative of Bœotia, the Thebans were excluded from the peace. Cleombrotus was sent by the Spartans to invade Bœotia, but was defeated at Leuctra (371 B.C.), chiefly through the tactics of Epaminondas. Two years after Epaminondas and Pelopidas were made Bœotarchs. They detached several nations from the alliance of Lacedæmon, and delivered the Messenians, whose capital they rebuilt. Epaminondas then marched with his army to Sparta; but this city was so bravely and skilfully defended by Agesilaus that the Theban hero retreated. An accusation was brought against him on his arrival in Thebes, because he and Pelopidas had kept the Bœotarchate beyond the legal time; the accusation was literally true, but the infringement of the law was justified by his services, and after having pleaded his own cause, he was acquitted. In 368 he compelled Sicyon and Pellene to relinquish the Lacedæmonian alliance, and in the same year served in a Theban army sent into Thessaly to rescue Pelopidas, who was kept a prisoner at Pheræ. In the following year he commanded an expedition with the same object which was successful. In 362 he was compelled to make head against a formidable coalition of states, including Athens and Sparta. His tactics were never more brilliant and successful than in this campaign, but in the battle of Mantineia he was killed at the moment of victory.

Ep'aphus, the son of Jupiter and Io, who caused Phaëton's destruction by denying his divine descent.

Ep'arch (ἔπαρχος *eparchos*), an ecclesiastical term formerly in use as equivalent to archbishop or metropolitan. In the national Russian Church bishops are all called eparchs as well as bishops, as in English they are currently styled “ordinaries” (Lat. *ordinarii*) and “diocesans” (Lat. *diœcesani*). The sees or territorial jurisdictions of bishops in the Russian Church are eparchies.

Epaulement, ĕ-pâl'mĕnt, in fortification, a term originally employed to denote a mound of earth, raised to protect a body of troops at the extremity of their line; or a screen or rampart erected, as a sort of shoulder, to defend the flank of a battery from enfilading fire, which would dismount its guns. In modern artillery, the word is applied to the whole mass of earth, stone, or fascines raised to protect a battery both in front and at the flanks. It is also used of the breastwork set up to shelter reserve artillery.

Epaulet, ĕp'â-lĕt, an ornamental badge, consisting of a fringe hanging over the shoulder, worn in the English army up to 1855, and still worn in the English navy by all ranks above lieutenant. Epaulets were not partially discarded by the United States army until 1872, when none but general officers continued to wear them. In the United States navy the epaulet is worn by all officers above the rank of ensign. The French private soldiers wear epaulets of worsted.

Epée, Charles Michel, shärl mē-shĕl ā-pā, **Abbé de l',** French instructor of the deaf and dumb: b. Versailles, France, 25 Nov. 1712; d. Paris 23 Dec. 1789. Taking orders, he became a preacher and canon at Troyes, but later lived in retirement in Paris. In 1765 he first began to occupy himself with the education of two deaf and dumb sisters; and, as he asserted, without any previous knowledge of Pereira's efforts in the cause, invented a language of signs, by which persons thus afflicted might be enabled to hold intercourse with their fellow-creatures. He determined to devote his life to the subject. At his own expense he founded an institution for the deaf and dumb, which was first publicly examined in 1771, and from 1778 received an annual subsidy. It was not, however, converted into a public institution till two years after his death.

Epeira, ĕ-pī'rạ, a genus of spiders, typical of the family *Epeiridæ*, comprising some of the largest and best-known spiders, those building orb-webs. They occur in all parts of the world, and are usually handsomely marked. See ORB-WEAVER, and SPIDER.

Epenceph'alon, one of the names to signify one of the primary stages in the development of the embryo brain. See BRAIN.

Eperies, ā-pār'yĕs (Slovak *Pressova*), Hungary, an old town on the Tarcza, 150 miles northeast of Budapest. It is the seat of a Greek Catholic bishop, and has a college, with 500 students. It manufactures earthen-ware, linens, and woolens, and has some trade in corn and Tokay wine; in the vicinity are the Sovar salt-works. Pop. 10,439.

Epernay, ā-pĕr-nā, France, in the department of Marne, in the midst of a rich vine-growing district; 19 miles northwest of Chalons. The earthen-ware called terre de Champagne is made in Epernay. Pop. 20,512.

Ephah, ē'fạ, a dry measure of capacity among the ancient Hebrews, corresponding with the liquid measure bath. The ephah contained about 36 litres French, equal to 9½ gallons of the United States, or 8 gallons British. There were, however, two measures called ephah, of which the above estimate applies to the larger, and this contained one third more than the other.

Ephedra, ĕf'ē-drạ, a genus of shrubs used for decorative purposes in landscape gardening. In general appearance they resemble the horsetails. The flowers are small and inconspicuous. The species occur in all parts of the world, but are not hardy, and need protection from frosts. They flourish best in dry or rocky soils, and are easily propagated. Their fruit is said to be mucilaginous, eatable, sub-acid, and slightly pungent. The branches and flowers of the Asiatic species were formerly sold as styptics.

Ephem'era, -fem'e-rä, the typical genus of the insect family *Ephemeridæ* (q.v.).

Ephemeridæ, ĕf-ē-mĕr'ĭ-dē, a family of neuropterous insects characterized by the slenderness of their bodies; the delicacy of their wings, which are erect and unequal, the anterior being much the larger; the rudimentary condition of the mouth; and the termination of the 10-jointed abdomen in 3-jointed filiform appendages. The adult May-flies, or day-flies, as they are called, emerge from the chrysalis on the banks of the running streams in which the eggs are hatched, and, appearing usually toward sunset, are no less remarkable for their great activity than for their enormous numbers, and the brief period of their existence. The eggs, which are shed in a mass, drop into the water. The larvæ have elongated depressed bodies; setose antennæ, and long caudal filaments; and lamellar or tufted gills, symmetrically disposed on either side of the abdomen. They remain in the water for a year or two before undergoing further change, lying beneath stones, and leading a predaceous life, for which their strong jaws fit them. The rudiments of wings mark the commencement of the nymph stage, at the close of which they crawl out of the water, and cast the nymph integument. Their sexual immaturity prior to the second molt has led to their being named, at this stage, subimagos or pseudimagos. The larvæ, which are very similar throughout the family, are largely used as bait. There are many species in various parts of the world, divided into various genera. *Ephemera* and *Cœnis* have three caudal filaments; *Palingenia* and *Cloë* only two, but the larvæ have three. The posterior wings are absent in *Cloë* and *Cœnis*.

Ephem'eris, an astronomical almanac. The plural Ephemerides is applied to tables showing the places where the planets and heavenly bodies are found at noon of every day. It is from these tables that eclipses, conjunctions, etc., of the planets are determined. See ALMANAC (*Nautical*).

Ephe'sians, the Epistle to the, one of the books of the New Testament. It seems to have been sent by St. Paul to the people of Ephesus about 62 A.D., while he was a prisoner in Rome (Eph. iii. 1, iv. 1). He sent it to its destination by the hand of Tychicus (Eph. vi. 21). The Church at Ephesus had been founded by Paul himself, or at least he had raised it from the feebleness in point of numbers and knowledge in which it had been when he commenced his missionary work in that city. For two years he preached Christ, not merely to the permanent residents in Ephesus, but to the multitudes who resorted thither as pilgrims to visit the celebrated temple of Diana, then one of the wonders of the world (Acts xix. 10). When driven from the city, owing to a riot raised by one whose craft would have been in danger had idolatry fallen, he retained a deep interest in his converts; and, despatching Tychicus to inquire after their welfare (Eph. vi. 21), gave him the canonical 'Epistle to the Ephesians,' for the Church just named, with another to the Church at Colossa (Col. iv. 7). It is evident from the 'Epistle to the Ephesians' that the converts at Ephesus were mainly Gentiles (Eph. ii. 11, iii. 1), and prominent in the didactic part of the letter is the doctrine that Christ had broken down the middle wall of the partition which severs Jew and Gentile, putting both on the same level of privilege within his Church (Eph. ii. 11–22, iii. 1–6). The Epistle concludes with a series of practical exhortations.

Ephesus, ĕf'ĕ-sŭs, Asia Minor, a Greek city of Lydia; one of the 12 Ionian cities; near the mouth of the river Caystrus, now called Kutshuk Mendre. Ephesus is now represented by the village of Ayasoluk, about 36 miles from Smyrna, on the railroad to Aïdin. After belonging to the Ionians, it fell successively under the dominion of the Lydian and Persian kings. Its importance as a commercial city dates chiefly from the time of Alexander the Great. The apostle Paul lived for two years at Ephesus and established a Christian Church there, to which he addressed one of his epistles. Timothy succeeded St. Paul, and St. John is said to have had charge of the Church after Timothy, and to have died at Ephesus. It was long famous for its temple of Artemis (Diana), called Artemision, reckoned one of the seven wonders of the world. The temple was of the Ionic order, and was adorned with many pillars, each 60 feet high, and with numerous statues and paintings by the most celebrated Grecian masters. It had been destroyed seven or eight times before Pliny wrote, particularly by the notorious Herostratus, 356 B.C. The temple, however, was rebuilt by the Ephesians with more magnificence than ever, whose women contributed their trinkets to the general fund raised for this purpose. There were also many other temples here, a theatre, a stadium or race-course, gymnasia, odeum, etc. The site of the temple had become lost when it was discovered by Mr. Wood in 1867–9. In his excavations he found that the building measured about 343 feet by 164, and stood on a raised platform measuring 418 feet by 239. Important excavations have since been carried out here, and the theatre, important buildings connected with the gymnasium, and a splendid semicircular marble portico round the east side of the harbor have thus been disclosed. The Great Mosque or Church of St. John, the cave of the Seven Sleepers, and other interesting objects are to be seen here. Consult: Wood, 'Discoveries in Ancient Ephesus.'

Ephesus, Council of, the third general council of the Roman Catholic Church, held at Ephesus 431, principally to oppose the heresy of Nestorius, patriarch of Constantinople. It was convoked by the Emperor Theodosius II. at the instance of Pope Celestine I. and many Catholic bishops. Cyril, bishop of Alexandria, presided on behalf of Pope Celestine I. The number of bishops in the Council was about 200. Nestorius, adopting the teaching of Theodorus of Mopsuetia, denied the Church's doctrine of the incarnation, and held that instead of the Word being made man, he (the Word) simply had his special abode in the man Jesus Christ; and that hence Mary the Virgin was not θεοτοκος, God-bearing, mother of God, but only χριστοτοκος, mother of the Christ. The Council declared that Mary is θεοτοκος, *Deipara*, and that Jesus Christ is God and man. (See COMMUNIO IDIOMATUM.) Another Council was held at Ephesus — the "robber synod," as it is called — in 449 convoked by the same emperor to deal with questions of faith connected with the teachings of Theodorus and Nestorius. The presiding bishop, Dioscurus of Alexandria, backed by a rabble of monks, soldiers, and servants overawed the 135 bishops, compelling them to sign blank papers on which he wrote what decrees he pleased.

Eph'od, a species of vestment woven of gold, blue, purple, scarlet, and fine twined linen, worn by the Jewish high-priest. It consisted of two main pieces, one covering the back, the other the breast and upper part of the body, fastened together on the shoulders by shoulder straps. On each shoulder was an onyx stone set in gold, on which were engraved the names of six tribes according to their order. A girdle or band, of one piece with the ephod, fastened it to the body. Just above the girdle, in the middle of the ephod, and joined to it by little gold chains, rested the square breastplate with the Urim and Thummim. The ephod was originally intended to be worn by the high-priest exclusively, but a similar vestment made of linen was worn in later times by priests of lower rank.

Ephors, ĕf'ôrs, or **Ephori**, magistrates common to many ancient Greek communities. The most celebrated were the Ephori of Sparta. They were five in number, and were elected by the people annually, their authority being designed as a counterpoise to that of the king and council. They superintended the morals and domestic economy of the community; scrutinized the conduct of all officials, and even summoned the kings before their tribunal. The judicial authority and executive power eventually fell almost entirely into their hands; they became autocratic; opposed the extension of popular privileges; and arousing the antagonism of the kings and people, were suppressed temporarily by Agis IV., and by Cleomenes III., the latter murdering the Ephors 225 B.C.

Ephorus, Greek historian, flourishing in the 4th century B.C., from about 400 to 330 B.C.; was born at Cyme, in Aeblis, Asia Minor. His master, Isocrates, after training him in rhetoric, persuaded him to abandon oratory for history, and it was upon his suggestion that he prepared his universal history. This work 'Ἱστορίαι', in 30 volumes, was the first history ever written in Greece and was remarkable for its wealth of material and also for the fact that each book, containing a compact portion of the history with an introduction, was complete in itself. The history deals with the Greeks (outside of the mythical age) from the return of the Heracleidæ to the siege of Perinthus (340 B.C.), covering a period of over 700 years. His style of writing was loose and feeble, well meriting the remark of Isocrates, that he needed the spur, as Theopompus the bit. The history was used and praised, however, by Polybius, Diodorus, and Strabo. The main portions of the manuscripts have perished, only a few fragments remaining, which were published in Muller's 'Fragments Historicorum Græcorum,' Vol. I., pp. 234–277 (Paris 1868).

Ephraem Syrus, ē'fra-ĕm sī'rŭs, **Ephrem**, or **Ephram** (the Syrian), Syrian theologian: b. Nisibis, Mesopotamia; d. Edessa 378. He lived in Nisibis till 363, but thereafter in Edessa till he died, except intervals which he spent in prayer and meditation in the desert. He held humble rank in the hierarchy, that of deacon, but as a preacher attained high celebrity. He refused to be ordained a priest because he thought himself unworthy. His writings were very numerous, and many are extant. He used a poetic form in his homilies and harangues; and St. Jerome tells us that his homilies (translated into Greek, for he wrote in Syriac) were wont to be read in many of the churches of Greece immediately after the Scripture lesson. He was a valiant defender of Catholic orthodoxy against the heretics of his time — Bardesanes, the Gnostic, the Arians, and the Sabellians, the Manichæans and the Novatians. Some of his lyrics are remarkable for their simplicity and genuine poetic spirit. Even his homilies are of a poetic cast and form; and in the translation of some of them they are styled "rhythms."

Ephraim, the younger son of Joseph, and the founder of one of the 12 tribes of Israel. The tribe occupied one of the finest and most fruitful territories of Palestine; in the very centre of the land, and included the most of what was afterward called Samaria. It was bounded on the east by the River Jordan, on the west by the Mediterranean Sea and the tribe of Dan, on the south by the tribe of Benjamin, and on the north by that of Manasseh. The Ephraimites, when they left Egypt, numbered 40,500, and, being numerous and influential, often appear as the representatives of the 10 tribes, both in historical and prophetical passages of the scriptures. For a long time the ark and the tabernacle were situated at Shiloh. The tribe was the most warlike of all the Israelites as attested by their protests against Gideon (Judges viii. 1) and against Jephthah (Judges xii. 1–7) because they did not ask their aid in war. Joshua, who conquered the Holy Land, and Samuel, the prophet, were members of the tribe. Upon the death of Saul, the Ephraimites, in conjunction with all the other tribes except Judah, took part in the revolt of Saul's son Eshbaal (Ishbosheth), and recognized him as legitimate king in opposition to David (2 Sam. ii. 8–9), but upon his murder, submitted to the hegemony of Judah under David. Later, about 975 B.C., after the death of Solomon, the tribe revolted under Jeroboam against Rehoboam, the son of Solomon (1 Kings xii. 1–20), and with all the tribes except Judah, Simeon, part of Benjamin, and the Levites, merged into the northern kingdom of which they constituted the most important part. The separate kingdom still adhered to the name of Israel and made Shechem its capital. In 722 B.C. the kingdom was destroyed by the Assyrians.

Eph'rata, Pa., township and borough in Lancaster County; on the Reading & C. R.R.; about 50 miles northwest of Philadelphia. It is an agricultural and mining region with forests nearby. Ephrata was founded by Johann Conrad Beissel (q.v.) and his followers in 1735. The community established by Beissel was called "Order of the Solitary," and it resembled somewhat the Seventh-Day Adventists. Ephrata contains several very ancient and singular buildings, particularly the brother and sister house. These houses are large four-story structures, each contains a chapel, and is divided into small apartments, so that six dormitories, barely large enough to contain a cot, a closet, and hour glass, surround a common room, in which each mess have their meals. The dress of the brethren and sisters is that of the Franciscans, or White Friars. They are remarkable for their rigid adherence to the precepts and ordinances of the New Testament; they insist upon the washing of the feet before administering the sacrament; and are very observant of the Sabbath. They are peaceful and temperate and are distinguished for their music, which is composed and arranged by themselves. Prior to the Revolution they seemed to flourish, but now only a few of the order remain. Pop. (1910) townships, 2,565; borough. 3,192. Kuhns. 'German and Swiss Settlements of Colonial Pennsylvania'; Sachse, 'The German Sectarians of Pennsylvania,' 2 volumes.

Ep'iblast, one of the layers in the developing embryo from which the structures making up the skin and its appendages are developed; also called ectoderm. See EMBRYOLOGY.

Epic, from the Greek ἔπος, speech, ἐπικός a discourse, a poem of the narrative kind. This is all that the word properly signifies, although it is generally understood to be a poem of an elevated character, describing the exploits of heroes, as distinguished from the lyric representing emotion, and the dramatic representing action, these three classes comprising the different styles of poetical composition. As action is the object of the drama, so narration is that of the epic. But as the event related is something already past, the epic is less stirring, hence its more quiet tone, the pauses which may be allowed in the interest of the description, and the introduction of passages of philosophical reflections. Unity, however, governs the whole structure of the poem. The epic in a general sense is applied to all poems of a narrative character which illustrate the history of important mythological, religious, and national events, a distinction being made between epics of growth, which consist of collections of ballads or poems composed by different authors at different times, and dealing with a connected series of events, and art epics, in which the events are grouped around some great structural thought by a single poet. To the first class belong the Sanskrit 'Ramayana' and 'Mahâbhârata,' the Finnish 'Kalevala,' the German 'Nibelungenlied,' and the mediæval French 'Chanson de Ron' or 'Roland.' In the second class are the 'Odyssey,' the 'Æneid,' 'Paradise lost,' and 'Gerusalemme Liberata.' Such epics as the 'Iliad' and the Persian 'Shah Nameh' again belong to both classes. The term heroic epic or heroic poem is applied to such works as Homer's 'Iliad' and 'Odyssey,' Virgil's 'Æneid,' Spenser's 'Faerie Queene,' Ercilla's 'Araucana,' Aristo's 'Orlando Furioso,' and others, which describe the achievements of the gods and heroes of antiquity, or of the knights of mediæval chivalry. Poems again like Milton's 'Paradise Lost,' Tasso's 'Gerusalemme Liberata,' Dante's 'Divina Commedia,' and Klopstock's 'Messiade,' are sacred epics. Lucan's 'Pharsalia,' Camoen's 'Lusiad,' and Voltaire's 'Henriade' are historical epics. Goethe's 'Herman and Dorothea' may be described as a domestic epic. Such poems as Scott's 'Marmion,' Longfellow's 'Evangeline' and 'Hiawatha,' are genuine miniature epics, while Tennyson's 'Idylls of the King,' from its artistic consecutiveness of motive, belongs also to the family. Of the mock-epic order are such poems as Pope's 'Rape of the Lock,' Butler's 'Hudibras,' and Boileau's comic epic 'Lutrin.' Epics also may utilize prose as a vehicle of thought and while less regular in form than the pure epic, may nevertheless be quite distinct from the common novel, or ordinary fiction; the best examples of prose epics are to be found in the Franch language, as such are: Fénelon's 'Télémaque,' Marmontel's 'Incas,' and St. Pierre's 'Paul et Virginie.' Consult Lang, 'Homer and the Epic' (1893).

Epicardium. See HEART.

Epichar'mus, Greek philosopher and comic poet: b. Cos about 540 B.C.; d. 450 B.C. He lived at Syracuse, and there wrote his celebrated comedies, now lost. Their number is reckoned at 52, and the titles of 40 of them have been preserved. Before commencing his career as a comic poet, which he did somewhat late in life, he lived at Megara, engaged in the study of philosophy, both physical and metaphysical. The fragments of his poems which are preserved abound with philosophical maxims, and with speculative discourses. His genius was highly esteemed among the ancients by such judges as Plato and Cicero. The Sicilian comedy of Epicharmus, prior to the Attic, grew out of the mimes, which were peculiar to this island, making a sort of popular poetry. He arranged the separate unconnected scenes, exhibited in the mimes, into continued plots, as in tragedy. His comedies were long regarded as models in this species of composition, and were as much distinguished by their knowledge of human nature as by their wit and lively dialogue. The Sicilian comedy, in opposition to the Attic-Ionic, is also designated as the Doric comedy.

Epicte'tus, Stoic philosopher: b. Hierapolis, Phrygia, about 60 A.D. He lived at Rome, where he was the slave of Epaphroditus, a brutal freedman of Nero, whose abuse and mal-treatment he bore with fortitude. Epictetus himself did not leave any written account of his doctrines, which appear to have been of the most elevated kind. In his discourses he aimed to impress his hearers with the love of practical goodness. The foundation of philosophy he held to be the perception of one's own weakness and inability to do what is needful. His doctrines approach more nearly to Christianity than those of any of the earlier Stoics, and although there is no trace in what is recorded of them of his having been directly acquainted with Christianity, it is at least probable that the ideas diffused by Christian teachers may have indirectly influenced them. The excellence of his system was universally acknowledged. Banished from Rome by Domitian, Epictetus settled in Epirus, and although he possessed the favor of Hadrian, there is no evidence that he returned to Rome. His pupil Arrian, the historian of Alexander the Great, collected his maxims with affectionate care, in the work entitled, 'Enchiridion' ('Handbook') and in eight books of 'Commentaries,' four of which are lost. These reveal the simple and noble earnestness of the philosopher's character, as well as that real heartfelt love of good and hatred of evil which is often assumed to be an exclusively Christian feeling.

Epicureanism. Epicureanism as a philosophical doctrine has its rise in the teachings of its founder Epicurus, who was born in Samos in the year 342 or 341 B.C. He was the son of Neocles and Chærestrata. His father's name being the same as that of the great statesman Themistocles, suggested to the poet Menander a verse in which he contrasts the son of Neocles, who freed his country from slavery, with him who freed it from foolishness. In his early life, Epicurus taught in several schools in Asia Minor and in the year 306 came to Athens, where he founded a school of his own. By the subtle charm of his personality he attracted to himself a group of admiring friends and followers who were not only devoted to the teacher but were also fired with enthusiastic zeal for his teaching. They were his companions and friends rather than his pupils. Their meeting place was the famous garden of the master which has become so closely associated with the very name of the school. After the death of Epicurus in 270 his followers carried on his work and maintained the teachings and traditions of their leader with unabated earnestness and loyalty. Among the successors of Epicurus, the most conspicuous perhaps are Hermarchus, Dionysius, Apollodorus, Zeno, and Phædrus. But no one of his followers achieved marked distinction until we come to the time of T. Lucretius Carus, the interpreter and chief apostle of Epicureanism. Though a Roman, he had caught that Greek spirit which had been so brilliantly illustrated in the garden of Athens.

Epicureanism as a distinct school flourished with varying fortunes until a period as late as the 4th century A.D. With the decay and disappearance of the school, its influences however did not cease, but lived on, and will live; for Epicureanism represents an attitude of mind which will ever appeal most strongly to certain natures, and in a way to all natures. It is not in a strict sense of the phrase, a system of philosophy. It is rather a theory of life. It is essentially practical in its purposes, methods and results. So far, however, as Epicureanism may be called a system of philosophy, it falls into three parts — a system of canonics, of nature and of morality. By canonics is meant a system which exhibits certain canons or tests of truth. With Epicurus the supreme test of truth was to be found in the sensations. It is the same thought as that which is contained in the old adage — seeing is believing. He held that only the actual facts of a sensory experience can furnish a scientific basis upon which to construct a body of knowledge. The notions are to be regarded merely as generalized sensations, and all opinions are inferences which at the last analysis must rest upon simple sensations. The sensation as such, therefore, is the court of last appeal. Concerning his philosophy of nature, Epicurus taught that there were only natural causes. Any belief in supernaturalism he regarded as a superstition which only a weak intellect could possibly entertain. As regards the constitution of matter, he followed Democritus in the essential features of his atomic theory of the universe. He did not follow, however, with complete rigor the logic of his materialistic conceptions, for he allowed that there must be a distinction between the irrational, or more sensory part of the soul on the one hand, and on the other, the rational part which he regarded as the superior and controlling power of man's nature. Moreover, while denying the existence of the gods, as gods of providence sustaining the forces of nature, and ruling the destinies of man, he nevertheless believed in their existence as beings apart and wholly separate from mundane affairs. From the standpoint of his ethical system, the gods were of very necessity beings supremely happy, and such they could not be were they supposed to be in any way cognizant of the darker side of nature and the manifold ills of human life. According to Epicurus the great end to be attained through the study of nature was to disabuse the mind of any lurking superstition concerning the possibility of the supernatural.

It is, however, the ethical system of Epicurus which is the heart of his teaching, and it is this system that the term Epicureanism usually suggests to one's mind. With Epicurus man's chief end is the attainment of pleasure,— not in the sense, however, that life is a heedless pursuit of pleasure here, there, and everywhere. The end is pleasure, not pleasures. The supreme pleasure, the constant source of all other pleasures is the tranquil and happy mind. In placing the true source of pleasure within, Epicurus here differs from the earlier Cyrenaic who regarded man's happiness as consisting in the full round of delights, the sum total of all his actual enjoyments. Epicurus taught that mere bodily pleasures were not an end in themselves, but only as they minister to peace of mind. Violent excesses disturb, extreme asceticism torments the inner spirit of man. Therefore be not too indulgent, nor too rigorous with self. Study to attain the maximum of enjoyment with the minimum of distress. Let a wise prudence transmute both the good and the evil of life into a tranquillity of soul. In this conception of conduct, virtue is never an end in itself. It is always a means to an end. The end is happiness and so far as a life of virtue contributes to well being, so far only is it to be commended.

We find in Epicureanism and in Stoicism alike, the common endeavor to free man from the dominion of circumstance, and to establish an inner world of mind wholly independent of the outer world of chance events, of untoward influences, of hostile forces and fleeting delights. The Stoic, however, urged the repression of all desire; the Epicurean, on the other hand, urged its wise regulation. As Epicurus himself puts it, "It is not an unbroken succession of drinking feasts and of revelry, not the pleasures of sexual love, nor the enjoyment of the fish and other delicacies of a splendid table, which produce a pleasant life, it is sober reasoning, searching out the reasons for every choice and avoidance, and banishing those beliefs through which greatest tumults take possession of the soul. Of all this, the beginning and the greatest good is prudence. Wherefore prudence is a more precious thing even than philosophy: from it grow all the other virtues,— for, it teaches that we cannot lead a life of pleasure which is not also a life of prudence, honor and justice, nor lead a life of prudence, honor and justice which is not also a life of pleasure. For the virtues have grown into one with a pleasant life, and a pleasant life is inseparable from them." JOHN GRIER HIBBEN,
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Epicurus, ĕp-ĭ-kū'rŭs, Greek philosopher: b. Samos, 342 B.C.; d. Athens 270 B.C. He went to Athens 323 B.C., where he is said to have enjoyed the instructions of Xenocrates, then at the head of the Academy, but this he himself does not admit. Epicurus generally denied his obligations to other philosophers. Although some parts of his system are evidently borrowed from his predecessors, he claimed to be self-instructed, and treated his teachers with hostility and contempt. His stay at Athens, however, was brief; and on leaving it he went to Colophon, where his father was engaged in teaching, and began himself to give lessons in grammar. It was here, according to some accounts, that his attention was first turned to philosophy. He himself says he began his philosophical studies at the age of 14, but they may have subsequently taken a more distinct development. The inability of the grammarians to explain a passage about Chaos and the accidental possession of a copy of the works of Democritus are variously assigned as the cause of this new or more decided direction of his mind. From Colophon he went to

Mytilene and Lampsacus, where he engaged in teaching philosophy. He returned to Athens in 306, and purchased a garden in a favorable situation, where he established a philosophical school. Here he spent the remainder of his life. His mode of life appears to have been simple and temperate. He abstained, as a principle, from politics, and took no part in public affairs. During the latter part of his life he was afflicted with severe physical suffering which was borne with heroic courage.

Epicurus was a very voluminous writer. His works, however, are represented as full of repetitions and quotations. In ancient times his philosophy appears to have been more popular in Greece than in Rome, although his disciples were numerous in both. This is easily comprehended, as it was in fact a system engendered by the decline of public virtue in Greece, while the severest stoical philosophy was better adapted to the still active public spirit of Rome. Little is left of his numerous writings. Some fragments of a 'Treatise on Nature' were found at Herculaneum, and published by Orelli (1818). All other fragments have been published by Usener in his 'Epicurea' (1887). The chief account of his philosophy is contained in the great poem of Lucretius, 'De Rerum Natura,' one of the masterpieces of Roman literature.

Ep'icycle, in ancient astronomy, a small circle supposed to move round the circumference of a larger, a hypothetical mode of representing the apparent motion of the planets, which were supposed to have such a motion round the circumference of a large circle, called the deferent, having the earth in its centre. In modern times, the epicycle is used in order to express in a few words the numerical value of periodical functions of an unknown law. Thus if the fluctuations of the thermometer for a day be observed, the size and initial position of several circles may be calculated, such that if the centre of the 2d move uniformly round the 1st once in 24 hours, the 3d round the 2d once in 12 hours, the 4th round the 3d once in 8 hours, etc., the height of the centre of the 4th or 5th circle will be the same as that of the mercury. See ASTRONOMY.

Epicy'cloid, in geometry, is a curve generated by a point in one circle, which rolls on the circumference of another circle, either on the concavity or the convexity, and it thus differs from the common cycloid, which is generated by a point in a circle that rolls along a right line. The latter has sometimes been assimilated with the former, by considering the right line as the circumference of a circle whose diameter is infinite. The invention of epicycloids is ascribed to M. Roemer, the Danish astronomer. See GEOMETRY.

Epicy'cloidal Wheel, a wheel or ring fixed to a framework, toothed on its inner side, and having in gear with it another toothed wheel of half the diameter of the first, fitted so as to revolve about the centre of the latter. It is used for converting circular into alternate motion, or alternate into circular.

Epidaurus, ĕp ĭ dā'rŭs, one of the most important towns and commercial seaports of ancient Greece, situated in Argolis, in the Peloponnesus, particularly celebrated for its magnificent temple of Æsculapius, which stood on an eminence not far from the town. An inscription over the entrance declared it to be open only to pure souls. Crowds of invalids resorted to the place in hopes of obtaining a cure from the beneficent divinity, in whose honor festivals were celebrated yearly. It received its name from Epidaurus, a son of Argus and Evadne. It is now called Pidavro, or Edidairo, and is the place where in 1821 the first Greek Congress assembled. The modern town contains about 100 inhabitants. Consult: Diehl, 'Excursions in Greece' (1893).

Epidemiology, ĕp-ĭ-dē-mĭ-ŏl'ō-jĭ, the study of epidemics or the science that treats of those diseases that are known to attack a number of persons at the same time or in close succession. The essential feature is that epidemic diseases belong to a group of infective or microparasitic maladies which have the common property of spreading from time to time in a community. It is well known that many diseases of an epidemic character have their favorite haunts. In such places they are always present, and there they are said to be endemic. It is only when they appear in large numbers of people in their favorite habitats that they assume epidemic proportions. Thus there is little distinction between the two classes of disease, since the same disease may be at one time both endemic and epidemic. When an epidemic disease, for instance, influenza, spreads the entire world over, the word pandemic is applied. The essential feature in an epidemic disease is that it must have a definite contagium. The contagia may be either of bacterial or protozoan character. Thus cholera, dysentery, the plague are caused, as is known, by bacteria which, being carried in the ordinary paths of commerce, or by bodies of a moving population, are spread about the world. Occasionally epidemic disease is due to an animal parasite. This is presumed to be the case in yellow fever, and is known to be true of malaria. In malaria, as is now positively demonstrated, the agent that is all-important in the spreading of the disease is one genus of mosquito, *Anopheles.* The parasite lives normally in the human body, and is conveyed by means of the blood into the mosquito, where it undergoes a special cycle of development, until it is inoculated into another human being, who develops the disease.

Further, it may be said that the essential features for the development of epidemic conditions are: (1) A virus; (2) a susceptible population; (3) free intercommunication between the sick and the susceptible. In the group in which the animal parasites belong there must be: (1) A virus; (2) a breeding-place outside of man; (3) a means of transport from place to place, either naturally or artificially; (4) a vehicle for the diffusion of the disease, such as the mosquito, for instance, or a contaminated water-supply, or a person suffering from the disease who travels from place to place, and (5) a susceptible population. It is well known that variation in the susceptibility of populations is a very important element in the consideration of epidemics. Thus measles, whooping-cough, diphtheria, and similar affections ravaged Hawaiian (formerly Sandwich) Islands with a fierceness and mortality unknown to modern times. Seasonal movements, sectional fluctuations, time fluctuations, and oscillations are interesting features in the study of epidemics. By some writers the word epidemic is very loosely used to indicate certain waves of mental excitation which have caused and still cause mental storms throughout a community, as the dancing mania and similar occurrences. These cannot be spoken of as epidemics in the true sense unless one wishes to use the broad term of «emotional contagion.» Some of the most interesting epidemics of modern years have been the influenza epidemic of 1890, which traveled round the world in from three to four years, and the plague epidemic that was raging from 1895 to 1902, slowly traveling over the habitable globe. There have been no severe extensive epidemics in the United States, save the epidemic of influenza, for a great many years, and in civilized countries at the present time the chances for the spreading of more severe epidemics are greatly lessened by the application of the laws of modern hygiene as well as by procedures arising from the newly acquired knowledge concerning immunity. The time does not seem far distant when immunity to many forms of infectious disease may be conferred by proper serum therapy. Consult: Hirsch, 'The Geographical Distribution of Disease' (1893); Weichselbaum, 'Epidemiologie' (1900); and 'Epidemiology' in 'Encyclopedia Medica' (1900).

Epiden'drum, a large genus of tropical American orchids, most of the species of which are epiphytic, growing on trees. There are upward of 600 species in South America alone. The stems are pseudo-bulbs, the leaves are strap-shaped and leathery, and the flowers are single or in spikes, panicles, or racemes. The flowers of some species are very handsome, and a large number of the species are in cultivation. Two of the finest cultivated species are the Mexican plants *E. nemorale* and *E. vitellinum,* the former with rose-colored and the latter with orange-colored flowers. The plants are much used in hybridization, as they are hardy and rigorous, and are valuable for crossing with the less hardy species of other genera, the result being in many cases long-stemmed flowers of fine appearance.

Epider'mis. See SKIN.

Epidid'ymis. See TESTICLE.

Epididymi'tis, inflammation of the epididymis, resulting in pain, redness, heat, and swelling of the testicle, with general constitutional malaise. Treatment consists in rest in bed and soothing applications.

Ep'idote, a common mineral, usually yellowish-green in color, and crystallizing in prismatic forms belonging to the monoclinic system. It is a silicate of calcium, iron, and aluminum, with the general formula $HCa_2(Al, Fe)_3Si_3O_{13}$, the ratio of the aluminum to the iron varying, in different specimens, from 6:1 to 3:2. Its hardness is from 6 to 7, and its specific gravity is about 3.4. Epidote occurs throughout the world. Fine crystals are found in France; the Tyrol; Haddam, Conn.; Calumet, Colorado; and Alaska. The epidote group contains, in addition to epidote proper, the minerals piedmontite and allanite, which resemble it in general nature but contain manganese and cerium respectively; and also the calcium epidote, zoisite, which crystallizes in the orthorhombic system.

Epigæa, ĕp-ĭ-jē'ạ. See ARBUTUS, TRAILING.

Epigas'trium, the upper fore part of the abdomen, reaching from the pit of the stomach to an imaginary line above the umbilicus (navel) supposed to be drawn from the one extremity of the last false rib, on one side, to the corresponding point on the other.

Epigene, ĕp'ĭ-jēn, a term applied to those geological agents of change which affect chiefly the superficial portions of the earth's crust, as the atmosphere, water, plants, and animals.

Epigenesis, ĕp-ĭ-jĕn'ĕ-sĭs, in biology, the development of the animal from the simple protoplasm of the egg. This term therefore expresses the theory and process of embryology as now understood, and is opposed to the prevailing theory, previous to the researches of Harvey, and especially of Wolff and Von Baer, which was then known as the *emboitment* theory, an account of which is given under PREFORMATION. See also EMBRYOLOGY.

In physiology the supposed production in organized beings of or additional formations by means of new vital influences, as opposed to the idea that new parts are simply the result of developments or changes in pre-existing structures.

Epiglot'tis, the cartilage at the root of the tongue forming a valve which partly closes the aperture of the larynx during the process of swallowing. When respiration takes place the epiglottis is vertical but falls back and covers the larynx on the approach of food. Any portion of food, however minute, entering the sensitive larynx, causes distress and is automatically ejected by a spasm of coughing.

Epigoni, a name given in Greek legend to the sons of the seven Greek chiefs who conducted the expedition against Thebes in the war between Eteocles and Polynices. The name literally means descendents, successors, or heirs, and the second expedition in command of the sons to avenge the first disastrous defeat was thus called the "war of the epigoni." The name is also applied to students who attempt to develop the ideas of the great masters of a previous period.

Epigram. The Greek noun from which the word epigram comes was originally used to denote a prose inscription on a temple, tomb, statue, votive-offering to a god, or the like. Conciseness and brevity were, therefore, essential qualities. To give pleasure to the ear and help the memory, the Greeks next chose some poetic form for them, preferably the elegiac distich. Their use for practical purposes eventually suggested their composition as a form of literature, with subject-matter sometimes wholly imaginary. These poems now often embraced several distichs, and appeared in other metres, but continued to be ordinarily of a simple, expository or descriptive nature. In the Alexandrine period, however, when poets affected almost exclusively short but highly elaborate poems, epigram lost much in simplicity while attaining its highest popularity among the Greeks. Its composition had become the pastime, and even the serious ambition of authors of first rank, and its recitation and improvisation one of the favorite entertainments at symposia and other social gatherings. Collections of epigraphical epigrams were made. Meleager of Gadara followed these early in the first century B.C. with his «Garland» of literary epigrams, the prototype of our Greek Anthology or «Bouquet of Flowers.» This numbers about 4,500 poems by over 300 writers in two collections, the Palatine Anthology of Constantinus Cephalas (early 10th A.D.), and that which Planudes made four centuries later, supplying important additions. These collections with countless poetical inscriptions found in modern times constitute for us Greek epigrammatic literature. The Greek Anthology not only throws valuable light on human life from the time of the Persian wars to the age of the Byzantine collectors, but through widespread translation and imitation has deeply affected modern languages and thought. For the names of the prominent writers and a characterization of their work see the special article «Anthology.» As a literary genre imported from the Greeks, epigram enters Latin literature with Ennius, but as an inscriptional poem much earlier. Latin is peculiarly adapted to a lapidary, epigrammatic style, and certain racial characteristics, in particular their devotion to the practical, made the Romans naturalize this species of poetry at once. At first they modeled after the Greeks, and we have a few specimens of the erotic epigram as the Alexandrines wrote it. By Cicero's time most of the literary men of importance were writing epigram, and its value as a political weapon was fully appreciated. Catullus is, however, the only writer from whom we have any considerable collection. Although we find in him lyric qualities as fine as in the poems of the Anthology, it is still clear that the national aptitude for satire has already turned epigram strongly in that direction. It is the Latin satiric epigram and not the more lyrical Greek that becomes the model for modern writers. In the Augustan Age, Domitius Marsus and Pedo Albinovanus were, according to Martial, the greatest epigrammatists, but we have not enough of their work to judge it. Martial himself brought this branch of poetry to its acme. None of the eminent poets who followed in his steps, Petronius, Apuleius, Ausonius, and Claudian, have equalled him in epigram. In the sixth century Luxorius maintains the tradition, but at a low level. About this time the Salmasian collection was made which forms the nucleus of the modern compilations which we call the Latin Anthology. In the time of Charlemagne epigram enjoyed a veritable renaissance, taking the inscriptional form to describe the material glories of Christianity as well as to sing the praises of the dignitaries of the church. Then the humanists, to whom Latin was almost a second mother tongue, revived this form once more. But the Latin scholars who have written epigrams are too numerous to name here. One, John Owen of Oxford, should not perhaps be passed by, since he devoted himself wholly to this field and with marked success. In English literature the composition of epigram has long been out of fashion, but for centuries it was popular with literary men. Notable achievements in this line are to be found in the works of Herrick, Johnson, Dryden, Swift, Prior, Addison, Johnson, Goldsmith, Congreve, Hood, Hook, Byron, and Burns. Pope's poems might be reckoned a conglomeration of epigrams. Some of the best in our language are by Landor, who cutting loose from the Latin type, at times becomes a Greek in spirit. Epigram has enjoyed wide favor in other modern tongues. In Italy, it long played an important part in politics, as both the Pasquino and Marforio in Rome would testify, could they speak, but it has gradually given way to the madrigal and sonnet. In France from the time of Clément Marot, who introduced it from the Latin, the satiric sort has enjoyed a wonderful popularity. Boileau, J. B. Rousseau, Piron, Lebrun, and Chénier have shown its possibilities in many lines. The poetic Priamel of the 14th century may be said to begin epigrammatic literature in Germany, where indeed it has always inclined more to the moral and didactic than in the Latin countries. Among her more eminent epigrammatists are Opitz, Friedrich von Logau who is the best of all, Wernicke, Kästner, Klopstock, Lessing, Herder, Schiller, and Goethe, who brought out their «Xenien» together in 1797, Haug, and in more recent times Bodenstedt, Vischer, and Fulda. We pass from the history to the theory of epigram. Since it is unlimited in its choice of subject, the form and not the contents must determine whether a poem is an epigram or not. Lessing has shown much acumen in tracing the essential elements of the epigram in its modern conception to the primitive type, the inscription. Just as a monument arouses in a spectator a curiosity about the author and purpose of its construction, which the inscription then satisfies, so the first part of a literary epigram, whether dealing with some material object, or not, is intended to excite an interest which the close of the poem must duly satisfy. The suspense may be increased by making the prefatory portion of some length. The more remotely separated and apparently contradictory the ideas that are brought together, and the briefer and more unexpected the commentary or explanation at the end, the more successful we deem the poem. This point or conclusion becomes in the satiric epigram a sting. Hence the frequent comparison of an epigram to a bee or wasp. While the above applies to most epigrams as written to-day, no definition is quite satisfactory with reference to much that the ancients included under the term.

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Ep'ilepsy, a disease of the nervous system, characterized for the most part by a sudden brief disturbance of the brain functions, and usually attended with a loss or a diminution of consciousness, with some degree of convulsive muscular action. In the vast majority of cases the temporary loss of consciousness permits of the loss of muscular control, and the patient falls; hence the old name, the «falling-evil,» or «falling-sickness.» Epilepsy is a disease which was recognized in its pure type by the most ancient observers. Hippocrates described it, and evidences are found in the earliest Indian writings of Charaka that the disease was then known. The present belief is that the primary disturbance of function which induces the epileptic attack takes place in the cortex of the brain, usually involving the motor centres; but this is not essential, since it may spread from other centres to the motor region, or the disturbance may be confined entirely to other portions of the brain, resulting in anomalous epileptic seizures.

A single convulsion does not constitute an epileptic attack, nor do a few convulsions. Convulsions of reflex origin are extremely common in childhood and infancy, and get well on the removal of an irritant, such as impacted fæces or a tight prepuce, or muscular defects in the eye-apparatus. These are not epilepsies. One of the distinguishing features of epilepsy is the tendency to a recurrence of the attacks. Gowers says: «As a disease, it consists in the repetition of attacks which depend upon the fact that every functional state of the brain, normal or abnormal, leaves behind it a condition in which the same functional state occurs with greater readiness. The effect is the greater the more often the functional attack has occurred. The tendency to the recurrence of attacks of epilepsy of every form is increased by each one. Every fit, slight or severe, is in some degree the effect of those that have preceded it, the cause of those that follow it. This residual disposition of repetition of the same activity is the physical basis of memory, of muscular training, of all cerebral education, and it is the basis of the morbid education of the brain which underlies epilepsy. The recognition of this is essential for an adequate comprehension of the causation of epilepsy and also its successful treatment.» Further, as Gowers observes, «If we can perceive the conditions that underlie normal action in the nerve-centres, the phenomena of epilepsy will become in some degree less mysterious. In health, energy is liberated in instant response to a definite stimulus. Such capacity for instant activity involves a delicate equipoise of the processes for the liberation of nerve-force and for its restraint or control. The balance must depend upon the processes of nutrition in the nerve-structures, for the liberation of energy depends upon the occurrence of chemical processes under the influence of life — processes which must be ever on the verge of disturbance. But the conditions of nutrition must involve constant tranquil molecular changes, and, as a consequence, some degree of equally tranquil functional activity. The store of latent energy must be maintained by nutritional processes, which involve a constant overflow of energy, as from a vessel filled to the brim and delicately poised, into which water is gently flowing, but the equilibrium of which is easily disturbed, with a resulting energetic discharge.»

The symptoms of epilepsy in all its forms are too numerous to be treated outside of medical works. Suffice it to say, in general, that the kinds of epileptic attacks are, for purposes of convenience, divided into two classes — the severe form, to which the term *grand mal* has been applied, and in which there is loss of consciousness often prolonged, with severe muscular spasms; and the slight attacks or *petit mal*, in which there may be slight temporary loss of consciousness with slight muscular spasm, or only slight muscular spasm without loss of consciousness, or slight disturbance in the conscious field without recognizable muscular movements. There are minor attacks, often called «faints,» «turns,» «queer feelings,» etc., but they should not be mistaken for closely similar phenomena attendant on menstruation, indigestion, weak heart and circulation, etc.

In a typical *grand mal* attack, eschewing all refinements, the patient may have some sort of a warning of the oncoming storm. This is called the *aura*, and is usually present in from 30 to 40 per cent of all cases. This aura may be motor, sensorial, or intellectual. Thus the patient may feel a wave of hot air passing over the body; may have a sensation of griping at the throat; there may be a feeling of great buoyancy or exaltation. There may be abnormalities in taste, smell, sight, or some flashes of light, dark objects; partial blindness, roaring in the ears, noises in the head, bad taste in the mouth, indescribable sensations in the pit of the stomach — all these are types of the initial warning. Suddenly after this warning, or almost simultaneously with it the patient falls to the ground. Consecutively on this sudden fall severe tonic spasms of the muscles take place. Occasionally these spasms follow a definite order. Thus the fingers may be clutched, the arm raised backward and forward, one side of the body convulsed, this condition extending to the legs, the chest, the abdomen; and in *each succeeding attack the same order be followed*. When this occurs the disease is termed «Jacksonian» epilepsy, and this is one of the forms of the affection in which a localization of the cause can sometimes be made out. More usually, however, the attack is generalized. There are rigid, violent muscular contractions, which fix the limbs in irregular positions. It has been aptly described as a «clotted mass of movements.» The head and eyes may be turned to one side, the features are distorted, the face becomes flushed and then pale and livid from fixation of the chest and the loss of movements of respiration. The eyes may be opened or closed, the pupils more or less dilated as the patient becomes more and more livid. After this tonic intense contraction has lasted for a few seconds, the backward clonic movements of the reaction occur, and the most violent energetic movements of the muscles of the entire body may take place. The jerking movements gradually become less, or terminate in one violent distortion, and the patient lies senseless and prostrate and usually sleeps for some time. During the attack the urine, fæces, or semen may be passed.

As for the minor attacks (*petit mal*), they exhibit an endless procession of variations. In some there may be but a slight loss of consciousness; the patient, sitting down or leaning against a table or chair, suddenly stops in the middle of his play or conversation; a shade passes over the face, and in a moment he is himself again. Occasionally the patient feels sleepy, lies down for a second, and then gets up perfectly well. Occasionally there is a slight convulsion, an involuntary contraction and extension of some of the muscles without loss of consciousness, and the patient resumes his regular course of work or play. Occasionally the patient suffers from what is known as psychical attacks, during which there is an entire modification in the personality; and during the attack various automatic movements may be performed and a patient be entirely unaware of what he is doing. These automatic movements may persist for some time, a few seconds, minutes, an hour, a day, a week, in certain cases as long as a month, although these longer intervals are extremely rare and perhaps are something different. During such automatic condition the patient may wander from home frequent resorts, the character of which is unknown to him in his waking state, and may even commit homicide or suicide. The patients usually show great irritability and restlessness during these automatic states. These states are extremely common following *grand mal.* There are patients with epilepsy who show no other signs of the epileptic attack than this automatic condition.

Etiology.— The causes of the disease are predisposing and exciting: those that exist in the family history, and those that occur during the life of the individual. A great many cases of epilepsy are due to accidents during childbirth, especially when the labor has been prolonged and difficult: sometimes when it has been precipitate; both resulting in hemorrhage into the meninges of the brain or into the brain substance proper. Perhaps 70 per cent of the cases of infantile epilepsy are due to this cause. A neuropathic tendency is almost a *sine qua non* for the development of idiopathic epilepsy. Almost 40 per cent of these cases are found to exist in families that show this neurotic, run-down character. Alcoholism in the parents is of immense importance. Syphilis and tuberculosis are also important features acting as predisposing causes. Females suffer more from epilepsy than males, the proportion being about 52 to 48 per cent. Gower's analysis of 3,000 cases, bearing on the question at what age this disease commences, shows that 27 per cent commenced below the age of 10; 46 per cent between the age of 10 and 20; 15 per cent between 20 and 30; 10 per cent between 30 and 40; 1 per cent between 50 and 60; and ½ per cent between 60 and 80.

The course of the disease will naturally vary very widely. Actual mortality from epilepsy is very difficult to determine. The danger to life during an attack is not great, and although the patients may seem to be in an alarming condition, it is extremely rare for death to occur during a fit. Gowers has summed up the prognosis in idiopathic epilepsy as follows: "The prognosis is slightly more favorable if the patient is of the female sex, and distinctly more favorable if the disease begins over 20 than if it commences between 10 and 20. It is better the shorter the duration of the disease, and when the disease is inherited than when no heredity can be traced. It is better the greater the interval between the severe fits, and is least so in the cases in which attacks occur almost daily. It is better if the attacks occur in the sleeping or the waking state only than if they occur in both. It is better if there is no considerable mental change, and if the attacks are all of the severe variety, than if there are minor seizures, and better if the attacks are preceded by an aura than if they occur without warning. It must be recognized, however, that a really good prognosis can seldom be given unless all attacks are averted by bromide in moderate doses, such as 50 or 60 grains a day. Larger doses may diminish the fits but seldom effect a cure, and this is true also of the substitute for bromide. Successful results are sometimes obtained, but they are few. The prognosis in cases which "cannot bear" bromide is generally unfavorable so far as the prospect of a cure is concerned. But in all cases the ultimate result largely depends on the ability to secure persistence with effective treatment for a sufficient time, two or three years. Less does not secure the stability that allows the controlling agent to be discontinued with impunity. It is the case whatever the agent is. Premature cessation of treatment is certain to involve recurrence, and the fresh start is harder than the first. There is no short road to a cure, and the prognosis must be largely influenced by the presence of the necessary patience and wisdom.

Occasionally patients, while in the epileptic condition, suffer mortal accidents; a few die of asphyxia. Some, especially those with mild epilepsy, get well of themselves; but those with severe epilepsy usually continue to have their attacks at varying intervals, from several a day to one a day, one a month, one a year, throughout their lifetime, and die of intercurrent troubles. The end, however, that can be looked for in a great many cases of epilepsy is the condition known as *status epilepticus.* It may be regarded as the terminal stage in epilepsy. It consists of repeated and continued epileptic attacks, associated with high fever and usually ending in death. Patients in the condition of *status* may have as many as 300 or 400 convulsive attacks a day.

The prognosis of the disease, or the outcome, is a subject that cannot be decided on general grounds. It is always a question of the individual; but epilepsy in general should be considered as a very grave disorder with a poor prognosis, although careful treatment by a specialist may result in great alleviation if not permanent cure. There is probably no disease of the nervous system that requires more highly specialized knowledge to treat than epilepsy.

The diagnosis is extremely difficult, and epilepsy is confounded with a number of other conditions that have no relationship whatever to it. The lack of ability to make a correct diagnosis, with the extreme mendacity of the charlatan, is the basis of the many quack remedies on the market for the treatment of epilepsy. In the United States there are no less than 1,000 sure cures manufactured by various proprietors of quack medicines, most of which are solutions of bromides. Suffice it to say that most of these are worthless, and the cures brought about, as evidenced in many of the circulars, have been cures of other diseases than epilepsy.

The treatment of epilepsy is always a special problem. There is no such thing as the treatment of the disease; it is always the treatment of the patient. No general rules can be laid down in an article of this kind apart from the general observance of hygienic laws. An outdoor life, with a mild, healthy occupation, plain, digestible food, the absence of alcohol, tobacco, and other stimulants, a free intestinal canal, and surroundings in consonance with the mental capacity of the patient, are very desirable features. Medicinal treatment lies solely in the province of the family physician or the specialist. During an attack the patient should have a pillow thrust under the head, the clothes about the neck loosened, and he should be placed in a position that will not permit of self-harm. Otherwise the epileptic fit is best left untreated. For the treatment of the epileptic poor, modern philanthropy has devised epileptic colonies (q.v.).

Medico-Legal Relations.— Very frequently epileptics are a menace to society. In the automatic conditions which they exhibit, as already described, they frequently commit crime, and it becomes a matter of much importance to determine their responsibility at the time of the perpetration of such anti-social acts. Special consideration should be given to the heredity of the patient, to the previous course of the disease, and to the conditions surrounding the patient at the time of the act. It is at the present time a very popular plea for murderers to allege that they were epileptic at the time of the commitment of certain acts. This is a plea that is entitled to careful weight on the part of an intelligent jury, although there is little doubt but that at the present time it is greatly abused. Consult: Gowers, 'Epilepsy and Other Chronic Convulsive Diseases' (2d ed. 1901); Féré, 'L'Epilepsie' (1899); Binswanger, 'Die Epilepsie' (1900); Voisin, 'L'Epilepsie' (1899); Letchworth, 'Care and Treatment of Epileptics' (1900); Starr, 'Text-book of Nervous Diseases' (1903).

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Epileptic Colonies. The treatment and care of epileptics in special institutions may be said to be one of the developments of applied philanthropy of distinctly recent origin. By the founding of epileptic colonies is meant the setting apart of distinct tracts of ground for buildings and for the exclusive care and training of epileptics. The position of the epileptic in society is altogether anomalous. As Letchworth well says: "As a child he is an object of solicitude to his parents and guardians. The streets to him are full of dangers, and if sent to school he is apt to have seizures on the way or in the class-room. His attacks shock his classmates and create confusion. He cannot attend church or public entertainments, nor participate in social gatherings with those of his own age and station. In consequence of his infirmity the epileptic grows up in idleness and ignorance, bereft of companionship outside of the family, and friendless. He silently broods over his isolated and helpless condition." The recognition of these truths has caused philanthropists to found such colonies. In continental countries more has been done for epileptics than elsewhere, but in the last 10 years the movement for taking care of this unfortunate class of society has grown to large proportions and, as expressed by Peterson in his presidential address to the National Association for the Treatment and Care of Epileptics 1902, "there is hardly a community in the civilized world that is not now thoroughly aroused to the necessity for the treatment of this class of defectives."

This awakening took place about 1887, and has continued to the present time. The first distinct attempt to provide for epileptics was inaugurated by a Lutheran pastor, Friedrich von Bodelschwingh, who founded at Bielefeld, in Westphalia, Germany, the Bethel Colony, which, from small beginnings, has grown up to a village inhabited solely by epileptics. Here everything has been provided to meet their special needs, to make up for their deprivations in the outside world. They are supplied with schools to improve their minds, industrial teachers to make them more or less self-supporting, and physicians to study and treat their cases. Outdoor occupations are provided, special diet is arranged for, recreations, amusements, religious instruction, in fact all of the devices that go to make up a home, have been provided under this man's guidance, so that in 1903 at least 4,000 people, not less than half of whom are epileptics, are being taken care of in Bethel.

The success of the Bielefeld Colony prompted movements elsewhere. Other colonies were founded in Germany and other European countries. Ohio established the first institution for epileptics in the United States, although this was built on the hospital rather than the colony plan. New York has Craig Colony at Sonyea, one of the most elaborate and beautiful institutions of this class, closely modeled on the Bielefeld plan, and now (1903) with a population of nearly 1,000. Massachusetts has a colony at Palmer; Pennsylvania a colony farm at Oakburn; and there is a New Jersey State village for epileptics at Skillman. A colony for epileptics was begun in 1902 at Abilene, Texas, and there are movements on foot for similar establishments in Connecticut, Indiana, Illinois, Kansas, North Carolina, Missouri, Minnesota, and California. In England the first colony founded was at Chalfont in 1893 and another at Warford in 1900. There is also a colony, the Waghull Home, near Liverpool; another at Godalming; a large colony at Chelford, and finally a fifth institution in England is nearing completion (1903) for the city of London, not far from Croydon. Other colonies have been founded in Brazil, Belgium, Switzerland, Sweden, Russia, Italy, Turkey, India, Japan and Australia.

The Craig Colony, of Sonyea, N. Y., being one of the most modern and ideal, is selected as a type of this institution. Consult: Letchworth, 'Care and Treatment of Epileptics' (1900).

Epileptic Insanity, a mental complex accompanying epilepsy. It is characterized by a certain degree of mental deterioration, as shown in the impairment of intellect and memory, by impulsiveness, mental irritability, loss of moral sense, and partial or complete loss of productiveness. It is also accompanied by periodic disturbances, transitory attacks of anger, dream-states, or automatic phenomena. Many cases of epilepsy do not develop into epileptic insanity, but the mental deterioration may appear at almost any period following the onset of the epilepsy. In practically all cases of epileptic insanity there is pronounced weakness, mentally, morally, and emotionally. One's sense of one's surroundings is usually preserved, and consciousnes may be clear save during the dream-states or automatic periods. Comprehension is usually not markedly impaired, but the field of attention is diminished and easily diverted. Hallucinations are infrequent, illusions are common during an attack or following a grand mal seizure, and delusions are transitory, being found usually only in the dream-states. Morbid and sudden impulses are quite frequent, sometimes approaching distinct nerve-storms, during which suicidal and homicidal attacks may occur. The conduct otherwise is usually orderly, and the ordinary rules of propriety are observed. There is greatly diminished capacity for work in practically all epileptics. The subject of epileptic insanity is one deserving wide recognition as there are unquestionably a number of phenomena termed "psychical" epilepsy that need recognition by specialists. In some of these attacks the patients are confused. They move in a mechanical or automatic manner. They wander aimlessly about, recognizing no one, although sometimes answering incoherently when addressed. Occasionally they exhibit symptoms of excitement, at other times depression, and not infrequently they may set fire to their beds or furniture, commit theft, assaults, homicides, expose their persons, and otherwise conduct themselves in an irrelevant and insane manner. Treatment is always unsatisfactory. The patient should be kept in a sanatorium or asylum. See EPILEPSY.

Epilo'bium, the willow-herbs, a genus of plants belonging to the evening primrose family (*Onagraceæ*). The species are herbs or under-shrubs with pink or purple, rarely yellow, flowers, single in the axils of the leaves, or having terminal leafy spikes. The seeds are tipped with a pencil of silky hairs, and are contained in a long four-celled capsule. There are about 65 species scattered over the arctic and temperate regions of the world, 40 of them being found in the western and northwestern portions of North America. *E. hirsutum,* or codlins-and-cream, a great hairy willow-herb, is a common and conspicuous plant of waste places in New England and northern New York. Its flowers are pink and rather large, and the whole plant is very downy. Some species are cultivated, but are more common in England cottage gardens than in America.

Ep'ilogue (from the Greek *epi,* upon, and *logos,* word, speech), the closing address to the audience at the end of a play. The epilogue is the opposite of the prologue, or opening address. Many of Shakespeare's plays have an epilogue as well as prologue, in which the poet sometimes craves the indulgence of the spectators for the faults of his piece and the performance, and sometimes intimates in what light his work is to be considered. The epilogue is sometimes a necessary appendage, to tell us something of a composition, which cannot be gathered from the composition itself.

Epimenides, ĕp-ĭ-mĕn'ĭ-dēz, Cretan philosopher and poet: b. Crete, in the 7th century B.C. By some he is reckoned among the seven wise men, instead of Periander. When the Athenians were visited with war and pestilence, and the oracle declared that they had drawn on themselves the divine anger by the profanation of the temple, in which the followers of Cylon had been put to death, and must expiate their offense, they sent for Epimenides, who was renowned for his wisdom and piety, from Crete, to purify the temple. On his departure he refused to accept any presents, and only asked the friendship of the Athenians on behalf of Cnossus, his home. There is a story of his having, when a boy, slept in a cavern for 57 years. On awakening, he found, to his astonishment, everything changed in his native town. This story is the ground-work of Goethe's poem, the ‹Waking of Epimenides,› for the anniversary of the battle of Leipsic. According to some accounts he is said to have lived for upward of 150, according to others for nearly 300, years. He is supposed to be the prophet referred to by St. Paul in Titus i. 12.

Epimetheus, ĕp-ĭ-mē'thūs, in Greek mythology, a son of Iapetus and Clymene, and the brother of Prometheus. Against the latter's advice he married Pandora, who opened the box in which the foresight of Prometheus had hid all the ills by which mortals were liable to be afflicted. All kinds of diseases and torments issued out of the box, and hope alone remained behind. According to other accounts it was Epimetheus himself who opened the box. (See PANDORA.) It is to be remarked that, in the Greek tradition, curiosity and disobedience are made the origin of evil, as in the Mosaic account of the fall.

Epinal, ā-pē-näl, France, town, capital of the department of the Vosges, in a narrow valley on the Moselle, 190 miles east-southeast of Paris. It has a communal college, a public library of 20,000 volumes, a museum, a theatre, and hospital. The manufactures consist of articles in iron and brass, leather, oil, and chemicals; freestone and marble are quarried in the vicinity. Pop. 28,523.

Epinay, ā-pē-nā, **Madame de la Live d'** (LOUISE FLORENCE PÉTRONILLE TARDIEU D'ESCLAVELLES), French writer: b. Valenciennes 11 March 1725; d. Paris 17 April 1783. She was the daughter of M. Tardieu Desclavelles, and married her cousin D'Epinay. But his extravagance soon compelled her to separate from him. During the earlier part of her life she formed an acquaintance with Rousseau, who, quick and susceptible in all his feelings, devoted himself to the fascinating and accomplished woman with an ardor, the depth and strength of which he describes himself in his ‹Confessions.› She was not insensible to the homage of her "bear," as she used to call him, on account of his eccentricities, and did all that was in her power to place him in a situation corresponding to his wishes. She gave him a cottage (the Hermitage, since so famous) in her park of Chevrette, in the vale of Montmorency. Here the author of the ‹Nouvelle Héloise› passed many days, rendered happy by his romantic attachment to Madame d'Epinay; until he became jealous of Baron Grimm, whom he had himself introduced to her; and in consequence of this feeling, which he took no pains to conceal, a coolness, and finally an aversion, took place between him and the lady, which is but too plainly expressed in his ‹Confessions.› A defense of the later conduct of Madame d'Epinay toward Rousseau may be found in Grimm's ‹Correspondence,› where an account is also given of some works written by her, of which the most celebrated is ‹Les Conversations d'Emilie.› In this the authoress, in a rather cold but neat style, sets forth the principles of moral instruction for children, with equal elegance and depth of thought. It obtained, in 1783, the prize offered by Monthion (the chancellor to the Count d'Artois) for useful works of this kind, in preference to the ‹Adèle et Théodore› of Madame de Genlis. She also wrote ‹Lettres à mon fils,› and ‹Mes moments heureux.› An abridgment of her memoirs, and correspondence, showing her relations with Duclos, Rousseau, Grimm, Holbach, Lambert, etc., appeared in 1818. They give a true picture of the refined but corrupt manners which prevailed among the higher classes in France during the government of Louis XV.

Epior'nis, an extinct ratite bird of Madagascar (*Æpyornis maximus*), interesting not only for itself, but because its remains appear to have formed the basis for the Arabic tale of the gigantic roc. It was much like an ostrich in size and structure, except for the massiveness of its limbs and the extraordinary size of its eggs. These have been found in considerable numbers in muck-swamps, or sometimes floating in the river-mouths, often in perfect condition, and are the largest and strongest eggs known, measuring about 13 inches by 9½. These dimensions are twice those of an ostrich's egg, and an egg of the epiornis would hold the contents of six ostrichs' eggs, yet the epiornis was little if any larger. First made known to science about 1850, so many remains have since been found that about 12 species have been indicated, and a second genus (*Mullerornis*), which has been joined with *Æpyornis* into the family *Æpyornithidæ*. Tradition and the evidences of some bones indicate that these birds were exterminated since human occupation of Madagascar began. See MOA.

Epiphanius, ĕp-ĭ-fā'nĭ-ŭs, **Saint**, Greek father of the Church: b. of Jewish parents near Eleutheropolis, Palestine, about 315; d. at sea near Cyprus 403. In his youth he went to Egypt where at first he came under the influence of teachers of Gnosticism; but afterward he embraced monasticism, and returning to his own country there became head of a community of monks. In Palestine he made the acquaintance of the two western churchmen, Jerome and his associate, Rufinus; the friendship of the three men was cordial and intimate till Rufinus' defense of the teachings of Origen angered Epiphanius, whose special mission seemed to be to obliterate every line written by Origen. He was made bishop of Constantia (the older name Salamis), in Cyprus 367, and held that see till his death. On one occasion, 394, he visited Jerusalem to denounce Origenism. He must have been more than 80 years old, perhaps near 90, when he went to Constantinople to charge the patriarch of that see, Saint John Chrysostom, with the sin of favoring the Origenists, but a few words from Chrysostom opened his eyes. Of his numerous writings few remain; among them: 'Panarion, a history of Heresies'; 'Commentary on the Book of Canticles,' and some others. Consult: Tillemont, 'La Vie de S. Epiphane, avec l'Analyse des Ouvrages de ce Saint, et son Apologie.'

Epiphany, ē-pĭf'ạ-nĭ, a festival of the Catholic Church held on 6 January to commemorate the manifestations of Jesus Christ as son of God: (1) to the Wise Men of the East (Magi) at Bethlehem; (2) at his baptism by John in the Jordan, when the voice from heaven proclaimed, «Thou art my beloved son; in whom I am well pleased»; (3) at the marriage feast at Cana in Galilee, where Jesus wrought his first miracle. The observance of this festival can be traced to an earlier period in the eastern Church than in the western. In the Greek Church it was observed as early as the 2d century, but the event commemorated by the Greeks was not the visit of the Magi to Nazareth, but the manifestation of Jesus at the Jordan as the Messiah. Not till the 4th century does the Epiphany appear to have been observed in the Latin Church. In the Greek and Oriental churches it is customary to administer baptism on the eve of this festival with unwonted solemnity: this because of the relation of the festival to the baptism of Jesus by St. John. In those churches, too, the Epiphany (Epiphaneia, Theophaneia) was the festival commemorative of the birth of Jesus; for it was believed that the baptism in Jordan took place precisely on the 30th anniversary of the birth. A popular name for this festival in English is «Twelfth Day,» that is, twelfth day from Christmas; it is also called «Little Christmas.» In various other languages it is known as «Three Kings' Day,» or «Day of the Kings.» See MAGI.

Epiphyllum, ĕp-ĭ-fĭl'ŭm, a genus of plants of the natural order *Cactaceæ*. The few species seem to be confined to Brazil, where they are epiphytic upon trees. They have flat-jointed stems with blunt ends, from which the new branches and flowers are produced. These are borne in great abundance, on which account, and because of their brilliant red tints, this group of cacti is exceptionally popular in greenhouses, being probably the most useful of all cacti. They are easily propagated by means of cuttings or by grafting, particularly upon erect-growing species of other genera, and are generally used as hanging-basket plants, for which purpose their drooping habit specially recommends them. They need a porous, poor, fibrous soil and little water. The species most widely grown are *E. truncatum*, the crab or Christmas cactus, with numerous horticultural hybrids between it and related species, and *C. Gærtneri*, the Easter cactus.

Epiph'ysis. See BONE.

Epiphyte, ĕp'ĭ-fīt, or **Air-plant**, a plant attached to a tree or other support, organic or inorganic, living or dead, but from which it obtains no nutriment. The term air-plant has been popularly applied because these plants are typically neither parasitic, saprophytic, nor terrestrial, but depend upon the dust which lodges around them and upon the water of dew and rain. Strictly speaking, they are not air-plants, because this term implies no other source of life than air. Besides the typical epiphytes, which have representatives in many plant families, particularly the tropical orchids, bromelias, and ferns, there are many forms which are only partially epiphytic. In structure many of them exhibit adaptations for checking transpiration and for securing even minute quantities of water from the air or from objects to which they are attached. (See PITCHER-PLANTS.) Others (certain orchids) have storage organs which are usually specialized stems. Some have roots which serve only to anchor the plants to their support. In these, which are the most typical, the absorption of food takes place in the leaves and other green parts. Others are only epiphytic at first, since they later develop true roots which obtain food from the soil. The home of the largest number of epiphytes is in the moist region covered by tropical forests, the trees of which are often so covered with these plants that their branches are wholly concealed by a very miscellaneous growth. In the temperate and colder climates the epiphytal forms are confined almost wholly to lower orders of plant life such as liverworts, mosses, algæ, and lichens. These are also represented in the tropics, some of them even becoming attached to leaves of higher plants. Many of the flowering epiphytes are cultivated in greenhouses for ornament. Among the favorites are various species of *Nepenthes* (q.v.), orchids, and bromelias. One of the best-known American species, common in the southern United States, is the so-called Florida or Spanish moss (*Tillandsia usneoides*) of the natural order *Bromeliaceæ*.

Epirus, ē-pī'rŭs, a province of ancient Greece. It was separated from Grecian Illyria by the Ceraunian Mountains, and by the famous river Pindus from Thessaly. The river Acheron, also famous in mythological story, flowed through the limits of this province, and here were also the celebrated temple and sacred oak grove of Dodona, famous for its oracles. Pyrrhus, king of Macedon, was a native of Epirus, which country passed successively into the hands of the Romans and the Turks. It was ceded to Greece by the Turks in 1881. See GREECE.

Epis'copacy, that form of Church government in which one order of the clergy is superior to another; as bishops to priests and deacons. Much discussion has taken place on the subject of episcopacy. Nothing conclusive can be gathered concerning it in the New Testament; but there can be no doubt that it existed universally in the Church from the earliest historic ages down to the time of the Reformation, and it is inferred, as no change can be shown to have taken place, that the same constitution existed from the time of the apostles. Presbyterians and others argue, on the other hand, that, as there is nothing definite concerning it in Scripture, Christians are left a discretionary power of modeling the government of their Church in such a manner as may seem to them most meet; and that every Christian society has a right to make laws for itself, provided these laws are consistent with charity and peace, and with the fundamental doctrines and principles of Christianity. The power vested in the bishops or higher clergy differs very much among the different episcopal bodies. The Roman Catholic and the Greek Churches, as also the Church of England and the Methodist Church, are espicopalian. See BISHOP; ENGLAND, CHURCH OF; GREEK CHURCH; METHODIST CHURCH; CATHOLIC CHURCH, ROMAN.

Epis'copal Church. See ENGLAND, CHURCH OF; METHODIST EPISCOPAL CHURCH; PROTESTANT EPISCOPAL CHURCH; REFORMED EPISCOPAL CHURCH.

Episcopal Church, Reformed. See REFORMED EPISCOPAL CHURCH.

Episcopal Theological School, an institution situated at Cambridge, Mass. It was established in 1867 by Benjamin Tyler Reed, as a college for candidates studying for the ministry for the Episcopal Church. Students holding bachelors' degrees may obtain the degree of B.D., but those not holding such a degree receive only certificates.

Episcopal Theological Seminary, the name of an institution in Alexandria, Va., founded for the education of candidates for the ministry of the Protestant Episcopal Church. It was chartered in 1854, although the school was founded in 1823. Several scholarships have been established for worthy students. One of its renowned pupils was Phillips Brooks (q.v.).

Episco'pius, Simon, Dutch theologian: b. Amsterdam 1 Jan. 1583; d. there 4 April 1643. The religious movement known as Arminianism was fostered by him, and he was its leader after the death of Arminius. He was educated at Leyden, where in 1606 he received his degree of M.A. In 1610 he was ordained pastor at the village of Bleyswyck near Rotterdam. In 1611 the states-general, with the intention of putting an end to the agitations created by the controversies between the Gomarists or Calvinistic party and the Arminians or Remonstrants, ordered a conference to be held in their presence at The Hague between six ministers of each party. Episcopius was one of the six charged with the advocacy of Arminianism, and highly distinguished himself by good temper, ability, and learning. In 1612, the curators of the University of Leyden appointed him professor of theology in place of Gomar, who had gone to Seeland. This enraged the leaders of the orthodox party, who accused Episcopius of Socinianism, and of having entered into an alliance with the Roman Catholics for the destruction of Protestantism. By this the fanaticism of the populace was roused; he was insulted and abused in the street, and on one occasion narrowly escaped being stoned to death. The house of his brother in Amsterdam was sacked, under the pretext that it was a rendezvous of the Remonstrants. In 1618 occurred the famous Synod of Dort. Episcopius was present, with several other Arminians. The Calvinists, who were in an overwhelming majority, would not allow him to speak; they told him that the synod was met not to discuss, but to judge; and all the proceedings exhibited much bigotry and tyranny. Expelled from the church, and banished from the country, Episcopius betook himself first to Antwerp, afterward to Rouen and Paris, but 1626 returned to Rotterdam, where the *odium theologicum* against his party had become less virulent. Here he married in 1630, and four years later was made primarius professor of divinity in the newly established college of the Remonstrants. Episcopius held enlightened principles in regard to religious toleration. Not placing a high value on merely doctrinal views, but trusting rather to the efficacy of the Christian spirit to elevate and purify the character, and seeing, moreover, the presence of this spirit in men holding the most conflicting opinions (when not inflamed with controversial hates), he was desirous of a broader and more catholic bond of unity among Christians than the opinionative creeds of his day permitted. He wrote 'Institutes of Theology'; "Apology'; 'Confession,' etc. See Calder, 'Memoirs of Simon Episcopius' (1838).

Episode (Lat. *episodium,* from the Gr. ἐπεισόδιον, *epeisodion,* something adventitious). This term is employed by Aristotle in two significations. Sometimes it denotes those parts of a play which are between the choruses, and sometimes an incidental narrative, or digression in a poem, which the poet has connected with the main plot, but which is not essential to it. In modern times it has been used in the latter sense only. With the best poets the episode is not an unnecessary appendage, serving merely to swell the size of the work, but is closely connected with the subject, points out important consequences, or develops hidden causes. Of this kind is the narrative of the destruction of Troy, in Virgil's Æneid. This was the cause of the hero's leaving his country; but the poet does not commence with it because he wishes to bring the plot into a narrower space. He therefore inserts it in the course of the story, but so skilfully that we expect it in this very place; and it not only serves as a key to what has gone before, but prepares us for what is to come, namely, the passion of Dido. In this way the episode becomes an essential part of the whole, as it must necessarily be, if it is of any importance to preserve the unity of the poem. So with the tale in Wieland's 'Oberon'; it appears incidental, but explains to us the reason of Oberon's singular interest in the fate of

Huon. In epic poetry there is much more room for the episode than in dramatic, where the poem is confined to a present action. An excellent instance of the skilful use of the episode in the modern novel is given in Manzoni's I promessi sposi, in the tale of the 'Nun of Monza.' The term episode has also been transferred to painting, especially historic painting, in a sense analogous to that which it has in poetry.

Epistaxis. See Nosebleed.

Epistemology (ἐπιστήμη, knowledge or science, and λόγος, theory or discourse), or theory of knowledge, is an account of the nature of knowledge, treating of its origin and laws of development, its validity and relation to human experience as a whole. Investigations of this character fall within the field of general philosophy, and have usually been included under the heading of metaphysics. The word «Epistemology» is said to have been first used by J. F. Ferrier in his *Institutes of Metaphysics* (1854). Since its general adoption it has sometimes been taken to denote a field of inquiry co-ordinate with, and largely independent of, Metaphysics. It has been proposed to keep the investigation of the nature of knowledge distinct from the problems regarding the nature of being, and to call the former epistemology, and the latter metaphysics. The best usage of the present time, however, seems to retain the historical sense of the term metaphysics as the name for the more general field of philosophical inquiry which embraces both epistemology and ontology. (See also articles on Philosophy and Metaphysics.) Moreover, a logical justification for this usage is furnished by the fact that it is impossible to carry on the two branches of inquiry in isolation. It must undoubtedly be granted that for an ultimate ontology, or final view of the world, it is necessary to go beyond the merely cognitional aspect of experience and include in our synthesis judgments based on other orders of value than the merely logical. But it is at once obvious that we cannot take one significant step in investigating the nature of reality without some criterion of knowledge, *i. e.*, some theory of the conditions under which reality is known, and of what constitutes truth. It is perhaps not so evident that the nature of knowledge cannot be made the subject of inquiry without any reference to metaphysical theory. Indeed, it is not uncommon to speak of epistemology, as Locke does, as «a preliminary clearing of the ground» which is to be completed before any more ultimate metaphysical inquiries are to be undertaken,— if, indeed, these are to be undertaken at all. But this way of conceiving the matter is quite misleading. The figures which compare the knowing faculty to an instrument whose nature must first be understood, are here quite inapplicable. For knowledge has no existence by itself, or apart from and external to its objects. What we want, as Hegel has observed, «is to combine in our process of inquiry the action of the forms of thought with a criticism of them. The forms of thought must be studied in their essential nature and complete development; they are at once the object of research and the action of that object. Hence they examine themselves; in their own action they must determine their limits and point out their defects.» In other words, knowledge is never a mere series of ideas or mental representations that can be investigated apart from its relation to objects. In so far as it is knowledge it refers to and implies reality. To investigate its nature, then, is at the same time to test its conclusions regarding the nature of the objects with which it deals. But even if one refuses to take this standpoint, one must still admit the close connection of epistemology and metaphysics. For all theories of the nature of knowledge are based implicitly or explicitly on certain metaphysical assumptions regarding both the mind which knows and its relation to the objects known. Epistemology, then, cannot take one step without involving the ontological problems which some of its representatives seek to avoid.

It is likewise impossible to distinguish sharply the discussion of epistemological problems from logic. If a division can be made at the present time it is only in degree of ultimateness. It is possible, though perhaps not advisable, to limit the term «logic» to the somewhat narrow and abstract treatment which takes as its object the discovery of certain correct forms of thinking, or certain rules which are of practical value in testing arguments. When, however, logic breaks away from this narrow programme, as has been done by the more important recent writers, and carries on its inquiries in a philosophical spirit, it becomes identical with epistemology. Epistemology, logic, and metaphysics may thus be said to denote certain main points of view, differing somewhat in the treatment of various writers in emphasis and inclusiveness, rather than three independent and isolated sciences.

Psychology, as a natural science, however, occupies a different field, and has quite a different problem from epistemology. It is true that attempts have frequently been made to explain knowledge by beginning with cognitive mental states viewed as psychological processes. But the characteristics of the mental states and functions with which psychology deals have no immediate bearing on the problem of knowledge. For psychology is concerned only with the mode in which ideas exist; it investigates their quality, duration, intensity, etc., as well as their various modes of combination, viewing them as particular forms of psychical reality. Epistemology, on the other hand, is interested not in the existential aspect of ideas, but in their significance, in the universal and objective validity of experience as a body of truth. It thus seeks to bring to light the forms and functions of intelligence, noting the conditions and presuppositions under which it works, and the laws by which knowledge develops from its simpler and more fragmentary stages to the more complicated and coherent structure of science. It is a philosophy of experience rather than a description of individual states of consciousness.

Reflection on the nature of knowledge does not arise until a somewhat late stage in the development of the thought of the individual and the race. Thought first announces its conclusions confidently and fearlessly. It is not until this naïve confidence fails and scepticism arises that it is forced to reflect upon the nature of knowledge and its grounds of certainty. This is illustrated in the history both of ancient and of modern philosophy. The early Greek philosophers, as Hegel remarked, thought away fearlessly regarding the nature of reality. It was the collapse of those early systems and the scepticism of the Sophists (q.v.) which forced Socrates to take up the epistemological problem. In the same way the Stoic and Epicurean discussions regarding the canon of truth arose in response to the more outspoken and thorough-going scepticism of later times. In modern times the epistemological interest did not come into the foreground until Locke's 'Essay.' Locke's account of the origin of this work brings out very clearly the way in which problems of this character naturally arise: "Five or six friends meeting at my chamber, and discoursing on a subject very remote from this, found themselves quickly at a stand by the difficulties that rose on every side. After we had awhile puzzled ourselves, without coming any nearer a resolution of those doubts which perplexed us, it came into my thoughts that we took a wrong course, and that before we set ourselves upon inquiries of that nature, it was necessary to examine our own abilities and see what objects our understandings were, or were not, fitted to deal with . . . . Some hasty and undigested thoughts on a subject I had never before considered, which I set down against our next meeting, gave the first entrance into this discourse; . . . . and at last it was brought into that order thou now seest it."

Kant's 'Kritik of Pure Reason' was the work which placed epistemology in the foreground of continental philosophy. In the Preface to that work, he shows that the motives that led to his undertaking were very similar to those which influenced Locke. The scepticism of his time, he says, "is clearly the result, not of the carelessness, but of the matured judgment of an age, which will no longer rest satisfied with the mere appearance of knowledge. It is, at the same time, a powerful appeal to reason to undertake anew the most difficult of its duties, namely, self-knowledge, and to institute a court of appeal which should protect the just rights of reason, but dismiss all groundless claims, and should do this not by means of irresponsible decrees, but according to the eternal and unalterable laws of reason." Kant has a poor opinion of Locke's account of knowledge, and characterizes it as "a certain physiology of the human understanding." He himself proposed to inaugurate a method of Criticism which should give a new direction to philosophical inquiry, and at the same time furnish to it a sure foundation for further advance. Since Kant's time epistemological problems have largely dominated modern philosophy; and indeed, it has been maintained by many thinkers that the criticism of knowledge is the sole function which philosophy is able to perform, and that ontological speculation is vain and fruitless.

In the Pre-Kantian philosophy Rationalism (q.v.) and Empiricism (q.v.) were the main types of epistemological theory. The basis of the former was laid by Descartes (q.v.), who sought to universalize the method of mathematics, and by this means to secure the certainty of absolute demonstration in all fields. As mathematics starts from axioms and principles which are intuitively certain, and proceeds by means of reasoning to deduce all its other propositions from these as necessary consequences, so all science must derive its conclusions from fundamental and indemonstrable principles. These principles exist in the mind as *a priori* truths, and are universal and necessary in character. All science is thus built up by reasoning from general principles. Sense-perception and observation of particular facts were neglected, since it was held to be impossible to arrive in this way at the universal and necessary form of truth which science demands. It is evident that this theory of knowledge could more readily be applied to the general features of reality than to a determination of its particular details. And in the hands of Wolff (q.v.) and other continental rationalists it was occupied mainly in furnishing formal proofs of the existence of God, the nature of the soul, and the external features of the physical universe. Empiricism (q.v.), on the other hand, emphasizes sense-perception as the basis of all knowledge. Experience is described as a series of particular sensations and ideas in consciousness which are given to the mind from some external source. The mind itself is regarded as merely receptive, without any store of innate ideas, or of organizing principles. It was not strange, then, that in the hands of a genius like David Hume (q.v.), who carried this point of view to its logical outcome, empiricism should issue in scepticism. For if experience is nothing but a series of conscious states, each of which is "loose and separate" from all the others, it is impossible to know anything except these particular states in their isolation; impossible, therefore, to reach any universal propositions such as science demands. Again, if knowledge is limited to states of consciousness, it follows at once that there can be nothing known either of the nature of objects or of the subject or soul.

Kant (q.v.) did much to overcome the one-sidedness of these theories, and to give a more adequate account of the nature of knowledge. For, while he insists that knowledge must begin with experience, he points out that experience itself is a compound, implying both a given sense material and forms and principles of organization on the part of the mind. By his doctrine that "thoughts without perceptions are empty, while perceptions without thoughts are blind," he passed beyond the one-sided views of both Rationalism and Empiricism. By his transcendental method of inquiry he seeks to show what are the fundamental forms and categories which the mind employs in building up a coherent and universally valid system of experience. But, in spite of the great reform which he effected, he did not wholly succeed in reaching an organic view of experience. This was partly the result of presupposition which he inherited from the past, and partly due to his own tendency to make hard and fast divisions and distinctions. There always remained for him an unresolved dualism within experience between the datum of sense and the forms of thought. Again, thought, as he conceives it, does not pass beyond subjectivity and include in itself the nature of its object, but is occupied with bringing order and unity into sensations and mental representations. Although these states of consciousness, when thus acted upon by thought, become objective in the sense that they are parts of a universal and necessary system, nevertheless they are still only "phenomena," objects in the mind, while the world of real being (the things in themselves) remains inaccessible to knowledge. The spirit of Kant's philosophy undoubtedly leads beyond any such absolute dualism. But from Kant's day to the present time this distinction has appeared the final word of philosophy to many thinkers who continue to accept the presuppositions and categories of the past century, and who fail to apply to this problem the organic and evolutionary conceptions which are now within their reach.

Modern epistemological investigation may be described as seeking to exhibit the organic unity of experience. To reach this result, new theories regarding the nature of the mind and its relation to objects are necessary. In the first place, the conception of the mind as made up of a number of distinct faculties, must give place to the idea of the mind as a unitary system of functions which mutually coöperate and determine each other in the progressive development of experience. Secondly, the mind can no longer be regarded as a system of merely subjective functions related only in an external and accidental way to the real world of objects. The course of philosophical discussion has rendered it evident that if we begin by defining experience in terms of mental processes there is no way of deriving from these the world of objects. If our epistemological theory is to be adequate to experience as we know it, objectivity must be included within it. Thought, that is, is real only as a relation to objects; by itself, and apart from the world of real objects, it has no reality. It is only by thus recognizing from the beginning the essential relation of subject and object that it is possible to exhibit the real organic unity of experience as a system of knowledge. It was Kant's successors in Germany, and preeminently Hegel (q.v.), who first developed this organic view of experience. But partly on account of the form in which these systems were expressed, and partly as a result of the decline of philosophical interest, their most valuable and characteristic ideas failed for a long time to be appreciated. The credit of freeing these fruitful ideas from the somewhat obscure and uninviting form in which they were presented in the German systems of a century ago, belongs in the main to the English Neo-Hegelians and their co-laborers in America, among the latter of whom a place of honor must be given to Dr. William T. Harris, the late U. S. Commissioner of Education. The fundamental doctrine of these writers is that what is real is rational, *i. e.*, knowable in terms of reason, and therefore that all forms of cognitive experience can be exhibited as organically interconnected as a system of rational ideas or meanings. Conscious experience is from the first regarded, not as a series of psychological states, but as taking the form of a judging activity whose function is to interpret and reveal the nature of the objective world. Moreover, knowledge proceeds in its development through differentiation and integration in accordance with the fundamental laws of logical evolution. Its later and more highly developed forms are then to be understood as the differentiation and systematization of its more elementary forms and functions. The final truth regarding the nature of the real world must accordingly correspond with the ideal of completely developed and perfectly rationalized experience. As representatives of this general type of objective Idealism we may mention the late T. H. Green, Edward Caird, the late D. G. Ritchie, A. S. Pringle-Pattison, B. Bosanquet, W. T. Harris, John Watson, and Josiah Royce.

There are, however, prominent philosophical writers of the present day who employ to some extent Hegelian methods and principles in dealing with experience, but who yet maintain that the account of knowledge in terms of reason requires to be modified and supplemented in various ways. Two main points of view may be here mentioned, which have much in common, and which are both often emphasized by the same writers. On the one hand, it is claimed that logical thinking operates with universal concepts, and can therefore never do justice to the individual aspects of real objects. Thought, in other words, is concerned only with universal relations, and is unable to apprehend the uniqueness and particularity of real existence; it gives us only descriptions of things in general terms, and has to receive as a datum from another form of knowing the particular facts which form its subject-matter. This latter aspect of reality, it is maintained, can be apprehended only in some form of immediate experience. In fact, it is often maintained that logical experience must both start from and pass into direct intuition or feeling. In its beginning, logical thinking presupposes the awareness of objects in sense-perception; for it is claimed it is only in this way that thought comes into contact with individual things and gets a foothold in reality. Again, since the total system of things must exist in individual form, the final synthesis of knowledge must transcend logical relations and be realized, if it can be attained at all, in immediate intuition—a mode of cognition that may perhaps be described as analagous to æsthetic contemplation. Although the neo-Hegelian writers have not been backward in meeting these arguments, and have successfully shown the difficulties involved in their opponents' antithesis of universal and individual, of thought and immediate knowing, yet the discussion cannot be regarded as closed at the present time.

In a similar spirit the function of will and purpose as a fundamental element in experience is at present emphasized in many quarters. The intellectual or rationalistic account of cognitive experience is maintained to be inadequate, since it abstracts from the volitional element which alone gives to knowledge its function and significance. Concrete experience is the process of living, and living consists in the realization of purposes. So much may, I think, be granted: experience is essentially a teleological process and must be interpreted in terms of purpose. But purposes are only defined and realized through thought. Pragmatism (q.v.) (as the popular theory of the present day is called) goes further, and interprets knowledge solely in its relation to action. Knowledge is the instrument which the will employs to discover the means whereby practical purposes may be realized. It is thus never an end in itself, nor does its function consist in revealing the nature of a reality beyond experience. The function of thought is to effect the practical control of experience, and the only realities which it can define are terms within experience itself. Its problems are set by the particular situations and concrete demands which the developing process of experience presents. There is no intelligible problem regarding the nature of reality in general, or reality that does not exist as a particular functional element in concrete experience. Against this position various objections have been urged by many writers; the chief of which are: (1) that it does not reach a real organic unity of experience; (2) that it overlooks the fact that knowledge is an end in itself; (3) that it is subjective, and fails to recognize the objective and rational ends without which no real experience can exist.

At the present time perhaps the most important function of Epistemology consists in a criticism and evaluation of the fundamental conceptions and principles which underlie the procedure of the special sciences. These sciences set out from certain definite assumptions regarding the nature of the phenomena which they investigate, and with certain demands which their method of investigation has to fulfil. It is the function of Epistemology to make explicit the nature of these initial assumptions, and to show that the accounts given by these sciences are essentially determined by the character of these assumptions. Instead of assuming that the results of the special sciences are to be accepted at their face value as direct statements about the nature of reality, both philosophical epistemologists and workers in these sciences who have reflected on the problems of method (as *e. g.*, E. Mach and Karl Pearson) now agree that the view of the world given by natural science —and especially the mechanical theory—is itself a logical construction, based on certain assumptions which are necessary to carry out the purpose of the scientific co-ordination and explanation of facts. This construction must not be read apart from the purpose for which it was designed. Indeed, the prevailing tendency is to emphasize the merely methodological character of scientific results to such an extent as to make them appear almost arbitrary and devoid of any ontological significance. This is undoubtedly an extreme position. It must, of course, be admitted that the results of the special sciences are largely hypothetical and possess only relative truth. But they are never mere logical constructions in the sense that they are entirely divorced from reality. The ultimate purpose of science, as of all thinking, is to exhibit the structure of the real world, and the assumptions and hypotheses of the special sciences derive their significance and justification solely from their employment as means for the accomplishment of that end. In its task of criticising the assumptions of the special sciences, then, Epistemology cannot escape the consideration of metaphysical problems regarding the nature of the external world and its relation to the human mind.

Bibliography.—The bibliography of this subject is coextensive with that of general philosophy. A few works may be mentioned which deal with the more recent development of the subject:—Ormond, 'Foundations of Knowledge' (1894); Ladd, 'Philosophy of Knowledge' (1897); James, 'The Will to Believe'; Ward, 'Naturalism and Agnosticism'; Rickert, 'Die Grenzen der naturwissenschaftlichen Begriffsbildung' (1902); Münsterberg, 'Psychology and Life' and 'Die Grundzüge der Psychologie'; Dewey, 'Studies in Logical Theory' (1902); Seth, 'Epistemology and Metaphyics' and 'The Problem of Epistemology' (*Philosophical Review*, Vol. I, 1892); Seth, 'The Utilitarian Estimate of Knowledge' (*Philosophical Review*, Vol. X, 1901); Creighton, 'Methodology and Truth' (*Philosophical Review*, Vol. X, 1901); Albee, 'The Significance of Methodological Principles' (*Philosophical Review*, Vol. XV, 1906).

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Epistolæ Obscurorum Virorum, ĕ-pĭs'tō-lē ŏb-skū-rō'rŭm vĭ-rō'rŭm (Lat. "Letters of obscure men"), a collection of satirical letters which appeared in Germany in 1515-19, and professed to be the composition of certain ecclesiastics and professors in Cologne and other German towns. It is considered one of the most masterly sarcasms in the history of literature, and its importance is enhanced by the effect it had in promoting the cause of the Reformation through its attacks upon scholastics and monks. The authorship of this satire has been a fertile subject of controversy, but the major portion has been attributed to Reuchlin, Ulrich von Hutten, and Erasmus. The best edition is that of Böcking, supplementing his edition of the works of Hutten (Leipsic 1864-70).

Ep'itaph (Gr. ἐπιτάφιος, *epitaphios*, funeral, from ἐπι, *epi*, upon, and τάφος, *taphos*, tomb), an inscription upon a tomb. The earliest known are those upon Egyptian sarcophagi. Epitaphs were in use among both the Greeks and Romans. Many of the later Greek epitaphs were of considerable length, while those of the Romans commonly recorded only brief particulars regarding the deceased. The tombs of the Romans were placed near the highways, and their epitaphs generally commenced with, *Sta viator!* (Stop, traveler!). On Christian tombstones, epitaphs frequently express the pious hopes of survivors in reference to the doctrines of the Christian faith. In the catacombs of Rome, which were made a place of refuge by the persecuted Christians under the pagan emperors, are many remarkable epitaphs of this description.

Among memorable epitaphs, one of the happiest is that of Sir Christopher Wren, in St. Paul's, London, of which he was the architect:

> *Si monumentum quæris, circumspice.*
> "If you seek for his monument,—look about you."

The following is the epitaph of a Roman matron:

Domum servavit,
Lanam fecit.
"She kept the house and span the wool."
Sta, viator: heroem calcas,—
"Traveler, pause: thou treadest upon a hero,"

has been ascribed both to Montecuculi and to Gen. Merci.

Sufficit huic tumulus, cui non suffecerat orbis,—
"This tomb suffices for him for whom the world did not suffice,"

was the epitaph of Alexander the Great.

Count Tessin, a governor under Gustavus III. of Sweden, ordered the words

Tandem felix —
"Happy at last."

to be inscribed on his tomb. The following is Sir Isaac Newton's epitaph:

Isaacum Newton,
Quem immortalem
Testantur Tempus. Natura, Cælum,
Mortalem hoc Marmor
Fatetur.
"This marble acknowledges Isaac Newton mortal, to whose immortality time, nature, and heaven bear witness."

St. Anne's Church, at Cracow, has the following suggestive epitaph, dedicated by Count Sierakowski to Copernicus:

Sta, sol, ne moveare.
"Stand, O sun! move not."

Many so-called epitaphs are merely epigrams, never intended for serious use as monumental inscriptions. Among such may be cited that of Piron, on Marshal de Belle-Isle, who was buried next to Turenne:

Ci-gît le glorieux à côté de la gloire,
"Here beside glory lies the vainglorious."

For Greek inscriptions consult the 'Corpus Inscriptionum Atticarum' (Berlin 1878–82); for the Latin, the great 'Corpus Inscriptionum Latinarum' (Berlin 1863, et seq.); for those of modern times, Andrews, 'Curious Epitaphs' (London 1883).

Epithalamium, ĕp″ĭ-thă-lă′mĭ-ŭm, (Lat., from the Gr. ἐπιθαλάμιος, *epithalamios,* nuptial, from ἐπί, *epi,* upon, and θάλαμος, *thalamos,* a chamber); a nuptial song. Among the Greeks and Romans it was sung by young men and maids at the door of the bridal chamber of a new-married couple. It consisted of praises of the bridegroom and bride, with wishes for their happiness. Examples may be seen in Theocritus' epithalamium of Helen, and the three epithalamia of Catullus, in which the Greek form is much modified. Some Roman epithalamia were collected by Wernsdorf in Vol. IV. of his 'Poetæ Latinæ Minores' (Helmstedt 1789).

Epithelium, ĕp-ĭ-thē′lĭ-ŭm, one of the simplest forms of epithelial tissue, characterized by its non-vascularity, and consisting of flattened or columnar cells united into continuous membranes by an intercellular cement substance. Epithelium serves for the most part to protect exposed surfaces of the body, and performs the functions of absorption, secretion, and excretion. The epithelial tissues are developed from all three layers of the developing embryo. They themselves secrete their own cement substance. This takes on the form of thin plates between the cells, gluing them together. Occasionally the epithelial cells develop short lateral projections (prickles), forming with similar structures of neighboring cells intercellular bridges, between which are intercellular spaces filled with lymph for the nourishment of the cells. Inasmuch as practically all epithelial cells have one exposed surface and one surface lying in contact with tissues beneath, the upper and lower surfaces show certain variations of structure. Occasionally the free surface develops fine hairs or cilia. These are found in various localities. The outer surface of the cell, being exposed, develops more truly animal functions, the inner more vegetative. Blood vessels and lymph vessels do not penetrate, as a rule, into epithelial tisues, but they are richly supplied with nerve-end organs.

According to their shape and relation, the epithelial cells are divided into these varieties: (1) Simple epithelial cells, with or without cilia, comprising (a) squamous epithelium; (b) cubical epithelium; (c) columnar epithelium; (d) pseudostratified columnar epithelium. (2) Stratified epithelium, comprising (a) stratified columnar epithelium, with superficial flattened cells without cilia; (b) transitional epithelium; (c) stratified columnar epithelium. (3) Glandular epithelium. (4) Neuro-epithelium.

1. *Simple Epithelium.*—This is that type in which the cells lie in a single continuous layer. This form is found lining almost the entire alimentary tract, the smaller air-passages, the majority of the gland-ducts, the ovarian ducts, the uterus, the central canal, the spinal cord, and the ventricles of the brain. In (a) simple squamous epithelium the cells are flattened, forming a mosaic with the nuclei lying in the middle of the cell. It is found in the alveoli of the lungs. In (b) simple cubical epithelium the appearance is that of short polyagonal prisms. It occurs in the smaller bronchioles of the lung, in certain portions of the uriniferous tubules, the liver, pancreas, salivary and mucous glands. In (c) simple columnar epithelium the cells are pyramidal or prismatic. This type is found in the intestinal tract from the cardiac end of the stomach to the anus, and in certain portions of the kidney. Ciliated columnar is found in the ovarian duct and uterus, in the central canal of the spinal cord, and in some of the smaller bronchi.

2. *Stratified Epithelium.*—When the cells of simple epithelium increase to such an extent that layer upon layer is developed, the epithelium no longer remains simple, but becomes stratified. The lower layers are richly supplied with blood vessels, and multiply very rapidly, pushing out the upper layers that are constantly dying and being cast off. The various forms are: (a) Stratified columnar epithelium, with superficial flattened cells, forming the outer covering of the body, the epidermis and its continuations inside of the body, as, for instance, the walls of the œsophagus, the epithelium of the conjunctiva, the external auditory canal, the sheath of the hair-follicles, the walls of the rectum, the anus, and the vagina. The deeper cells are usually cubic-cylindrical, and are followed, as a rule, by one or more layers of sightly flattened cells, until finally the outmost layers become very much flattened and horny, or they may be developed into distinct horn-like substances such as that found in the nails. (b) Transitional epithelium, a type of stratified epithelium found in the kidney, uterus, urethra, and bladder. It is somewhat similar to the stratified columnar epithelium, but does not show the characteristic deep papillæ in the basal membrane, so characteristic of the former. (c)

Stratified columnar epithelium, consisting of a superficial layer of columnar cells and deeper layers of irregular, triangular, cubical or spindle-shaped cells. This type is found in the larger duct-glands, in the mucous membrane of the nose, portions of the male urethra, and in parts of the larynx. Many of this type of cells have cilia, particularly those found in the back of the nose, larynx, respiratory tract, larger bronchi, Eustachian tube, epididymis, and portions of the vas deferens.

3. *Glandular Epithelium.*—This is a type of epithelium occasionally found scattered among other epithelial cells, and which shows the characteristic of gland-structures. See GLANDS.

4. *Neuro-epithelium.*— Neuro-epithelial cells are highly specialized cells in which the nerve-end organs are to be found. See NERVE-END ORGANS.

Consult: Boehm and Davidorff, 'Text-book of Histology' (1900).

Epizo'a, in a general sense, external parasites, as contrasted with Entozoa, or internal parasites. These are not exact terms in scientific classification. Among them are the fleas, lice, ticks, itch-mites, and similar minute "vermin" infesting man or beast.

In a more restricted sense the term is applied to the degraded, distorted copepod crustaceans parasitic upon the skin, gills and other parts of marine animals, especially fishes. See FISH-LICE.

Epoch, or **Era** (Gr. *ἐποχή*, *epoche*, epoch, pause). In history, a fixed point of time, commonly selected on account of some remarkable event by which it has been distinguished, and which is made the beginning or determining point of a particular year from which all other years, whether preceding or ensuing, are computed. Some writers distinguish between the terms epoch and era. According to them, both mark important events, but an era is an epoch which is chronologically dated from; an epoch is not marked in this way. The birth of Christ was thus both an epoch and an era from this point of view.

The more important historical epochs are here enumerated. For further details on the mode of reckoning see CALENDAR.

The Creation.— The biblical record of the creation has formed the foundation of numerous chronologies. Of course the authorities (Jewish and Christian) on these various modes of reckoning do not agree as to the time signified by the common authority for the event dated from. The more important of these epochs, of which there are about 140 different varieties, are: (1) The epoch adopted by Bossuet, Ussher, and other Catholic and Protestant divines, which places the creation in 4004 B.C. (2) The Era of Constantinople (adopted by Russia), 5508 B.C. The civil year begins 1 September, the ecclesiastical year about the end of March. (3) The Era of Antioch, used till 284 A.D., placed the creation 5502 B.C. It was merged in the following year in (4) The Era of Alexandria, which made the creation 5492 B.C. This is also the Abyssinian Era. (5) Jewish Era. The common era of the Jews places the creation in 3760 B.C. Their year is lunar-solar, that is, lunar with intercalary months, forming a cycle of 19 years, of which 12 have 12 months and 7, 13 months. The year thus varies from 353 to 385 days. The civil year begins with the new moon following the autumn equinox. The eras dating from the creation are distinguished by the initials A. M. Const., Abyss., etc., are sometimes added to distinguish the particular epochs.

Julian Period.— This begins 4713 B.C. It is an arbitrary epoch, fixed for the purpose of computing all dates forward, as in the case of the creation epochs.

The Olympiads.—The Greeks computed their time by periods of four years, called Olympiads. Their year was lunar, with intercalary months. The first Olympiad, being the year in which Coræbus was victor in the Olympic games, was in the year 776 B.C. The period of the commencement of the year, which was variable, was about July. The contraction used for the Olympic epoch is Olymp.

The Roman Era (*Ab Urbe Condita*).— The Romans dated from the supposed era of the foundation of their city, 21 April, in the third year of the sixth Olympiad, or 753 B.C. (according to some authorities 752 B.C.). This epoch is designated by the initials A. U. C. The Roman mode of computation was the foundation of our modern chronology.

Era of the Seleucides.—Begins 1 Oct. 312 B.C., the epoch when Seleucus I. (Nicator) took possession of Babylon. The year consisted of 365 days, with a leap year every fourth year. This era is used in the book of Maccabees.

Spanish Era.— This dates from 1 Jan. 38 B.C. The months and days were the same as those of the Julian calendar. It was disused in Aragon in 1350; in Valencia, 1358; in Castile, 1383; in Portugal, about 1415.

Christian Era.—Our mode of computing from supposed data of the birth of Christ, was first introduced in the 6th century, and had not been generally adopted until the year 1000. Since the first year of the 1st century was 1 A.D., the last year of the same century was 100 A.D. Similarly the year 1900 A.D. was the last year of the 19th century. The same holds good in reckoning backward. For particulars of the mode of reckoning the years of the Christian era and the changes which it has undergone, see CALENDAR.

Armenian Era.—This began 7 July 552, and was superseded by the Julian era about 1330. The year consisted of only 365 days.

Mohammedan Era, or Hegira.—This begins on 16 July 622. The conversion of the Mohammedan into Christian chronology causes more difficulty and confusion than arises with any of the other modes of reckoning. The Mohammedan year is purely lunar. It consists of 12 months, and each month commences with the appearance of the new moon. Hence their years have no correspondence with the recurrence of the seasons, and to know the period when a Mohammedan year begins it must be reckoned from the beginning of the era. In chronology, history, etc., they use months of 29 and 30 days alternately, making the year consist of 354 days. Eleven times in 30 years 1 day is added to the last month, making 355 days in the year. The mean length of the year is thus $354\frac{11}{30}$ days, of the month $29\frac{191}{360}$, differing from the true lunation by little more than three seconds, or less than a day in 2,260 years. As 33 Mohammedan years amount to only 6 days (including intercalary days and leap years) more than 32 of our years, by deducting one year from each 33 Mohammedan years, and adding 621½ years, the year of the Christian era will approximately be found. The Hegira is distinguished by the initials A. H.

Persian Era.—The era of Yezdegird III. began 16 July 632. The year consisted of 365 days. It was reformed in 1075 by the addition of a day whenever it was necessary to make the commencement of the year occur on the day of the sun's passing the same degree of the ecliptic. The months have each 30 days, with 5 or 6 days intercalated. This era is still used by the Parsees in India.

Indian Chronology.— The best-known eras computed by solar time are the Kaliyuga, which dates from 3101 years before Christ and the Salivahana from 77 A.D. Both are computed astronomically, losing one day in 60 years by our computation. The era of Vikramaditya, beginning 57 years B.C., is computed by lunar months, with intercalations made according to astronomical observation, and bringing the year up to 365 or 366 days. The Bengali year was formerly identical with the Hegira, but is now reckoned by solar computation.

Chinese Chronology.—The Chinese, like all the nations of northeast Asia, reckon their time by cycles of 60 years. Instead of numbering them as we do, they give a different name to every year in the cycle. The Chinese months are lunar, of 29 and 30 days each. Their years have ordinarily 12 months, but a 13th is added whenever there are two new moons while the sun is in one sign of the zodiac. This will occur 7 times in 19 years. The boasted knowledge of the Chinese in astronomy has not been sufficient to enable them to compute their time correctly. The first cycle, according to Roman Catholic missionaries, began February 2397 B.C. To find out the Chinese time, multiply the elapsed cycle by 60, and add the odd years; then if the time be before Christ subtract the sum from 2,398; but if after Christ, subtract 2,397 from it; the remainder will be the year required.

Primitive American Chronology.— The natives of America, previous to its discovery by Europeans, particularly the Peruvians and Mexicans, appear to have had a considerable acquaintance with astronomy and to have reckoned their time with great care. The Mexican year consisted of 365 days, composed of 18 months of 20 days, and 5 added days. At the end of a cycle of 52 years 12 and 13 days were added alternately, making the mean year very near the truth.

In geology, Epoch has now a very different meaning from that which it formerly had. Instead of corresponding to a period in the history of the earth, it answers to a period in the history of a particular locality. Epochs are determined by the occurrence of particular kinds of animal and vegetable life in a group of strata which are marked off by unconformity above and below; the rocks were deposited and the organisms lived in that locality between the two great geological changes, one of which preceded the earliest deposit of the particular group of rocks, while the other closed the series. The conformably sequent strata of this series belong to one epoch; but the dissimilar animals and plants which lived elsewhere at the same time were either not preserved at all in deposits or were entombed in deposits of a different kind. In the latter case the assemblage would represent an epoch for that particular locality. Thus the Old Red Sandstone and the Devonian strata, the former lacustrine, the latter marine, were probably identical in epoch as they were contiguous in area. If we imagine the floors of the German Ocean and the Australian seas, just as they now are, to be covered by thick deposits of strata, these strata would, judged by their fossil contents, belong to different epochs; but we know that they only belong to different zoological provinces. Natural groups of strata represent, therefore, the epochs during which the animals and plants they contain lived and died in a particular area, and where a closely similar assemblage is found in strata at a distant locality we have therefore proof that during an epoch of unknown length similar organisms flourished there; but the epoch may have been before, identical with, or later than that first studied.

Used in this sense epoch is a term of only local application, and the proof that though the assemblage of rocks may be a natural one for one locality, it is not so for a great area, is found in the fact that the unconformities which indicate great geological change do not occur at identical points everywhere. Thus the Silurian and Old Red formations are conformable in England, unconformable in Scotland, and unconformities in both series are differently placed in America.

In astronomy, epoch is the longitude which a planet has at any given moment of time. To predict this for any future period the longitude at a certain instant in the past must be known; that instant is termed the epoch of the planet.

Epode (Lat. epodus, Gr. ἐπῳδός, *epōdos*). In Greek choral poetry the term is used of an ode succeeding a strophe and antistrophe, or a series of strophes and antistrophes. The name was also given by grammarians to any poem the metrical unit of which is a distich consisting of a long, followed by a short verse. In this sense it was especially used of the iambic trimeter followed by the iambic dimeter, as in Epodes 1–10 of Horace.

Eponym, ĕp'ō-nĭm, a mythical personage created to account for the name of a tribe or people; thus Tros is the eponymous hero of Troy, Italus was assumed as ancestor of the Italians, etc.

Ep'ping, England, market town, in Essex, 17 miles from London, and in the midst of the forest to which it gives name. This ancient royal forest, once a part of Waltham forest, and all much larger than at present, has an area of 5,600 acres, and presents some fine woodland scenery. It was secured to the nation by legislative enactment, and was opened by Queen Victoria in 1882 as a public recreation ground. The town consists of a single broad street on a ridge of hills.

Epping Forest. See EPPING.

Eprouvette, ĕ-proo-vĕt', the name of an instrument for ascertaining the strength of gunpowder, or of comparing the strength of different kinds of gunpowder. The simplest kind is the hand eprouvette, in the form of a very short pistol. The barrel or powder-chamber is closed by a plate communicating with a strong spring. On the explosion the plate is driven back to a greater or less distance according to the strength of the powder, and is retained at the extreme distance by a ratchet-wheel.

Ep'som, England, town in the county of Surrey, 15 miles southwest of London. Epsom was formerly celebrated for a mineral spring, from the water of which the well-known Epsom salts were manufactured. A number of the sons of medical men are educated at the Royal Medical College, and adjoining the school is a home for aged physicians or their widows. The principal attraction Epsom can now boast of is the grand race-meeting held on the Downs, which is attended by hundreds of thousands of persons. The races begin on Tuesday, and continue to the end of the week preceding Whitsuntide; the Derby stakes are run for on Wednesday, which is the principal day, and the Oaks on Friday. There is also racing on two days earlier in the season; the town being otherwise characterized as «a dull little place for 50 weeks in the year.» Epsom gives name to one of the parliamentary divisions of the county.

Ep'som Salt, a hydrous sulphate of magnesium, having the formula $MgSO_4 + 7H_2O$. It occurs abundantly in nature, and takes its name from its occurrence, in dissolved form, in a mineral spring at Epsom, England. It may be prepared also from dolomite, by decomposing the mineral by the addition of sulphuric acid. Epsom salt, proper, is known to the mineralogist as epsomite, and more popularly as hair-salt, from the delicate fibrous efflorescent deposits in which it often occurs on the walls of mines, quarries, and caves. Epsomite crystallizes in the orthorhombic system, and large quantities of it are found in the limestone caves of Kentucky, Tennessee, and Indiana, mingled with earthy matter. In the Mammoth Cave it occurs in loose masses suggestive of snowballs, adhering to the roof and walls. An allied mineral known as kieserite, which has the composition $MgSO_4 + H_2O$, and occurs abundantly at Stassfurt, is largely used as a source of epsom salt. Magnesium sulphate is used as a fertilizer, as a raw material for the manufacture of the sulphates of sodium and potassium, and in sizing and dyeing cotton goods. The epsom salt is also extensively used as a purgative, in medicine.

Epu'lis. See Mouth.

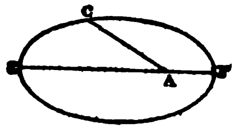
Epworth League, a society of young people of the Methodist Episcopal Church; formed 15 May 1889, in Cleveland, Ohio, by the union of five societies affiliated with the Methodist Church. It adopted as its motto: «Look up, Lift up,» and its declared object is to «promote intelligent and loyal piety in the young members and friends of the Church; to aid them in the attainment of purity of heart and constant growth in grace, and to train them in works of mercy and help.» The following pledge is required of its members: «I will earnestly seek for myself, and do what I can to help others to attain, the highest New Testament standard of experience and life. I will abstain from all forms of worldly amusement forbidden by the discipline of the Methodist Episcopal Church, and I will attend, as far as possible, the religious meetings of the chapter and the Church, and take some active part in them.» The league is governed by a board of control, partly appointed by the bishops, and partly elected by the General Conference districts, one member for each district; represented by an executive cabinet, consisting of a president, four vice-presidents, general secretary, general treasurer, and a German assistant treasurer. The league has grown rapidly, extending to foreign lands, and there are chapters in India, Mexico, South America, Italy, Norway, Sweden, Denmark, Finland, China, Japan, and Hawaii. On 1 Oct. 1902, there were in the league 29,600 chapters and 2,000,000 members. Its official organ is the 'Epworth Herald,' published in Chicago.

Equal Rights Party, in 1835. See Locofocos.

Equal Rights Party, in 1884. Belva Lockwood nominated herself for the presidency, on a platform of woman suffrage; and gave her voters this title.

Equality, a sociological work by Edward Bellamy (1897). Consult 'Equality'; 'Looking Backward.'

Equation, a term based on the idea of equality, in general use throughout the various branches of calculus. (1) In mathematics it is the statement in algebraic expressions of the equality of two or other mathematical expressions. The assertion of equality is made by writing the sign = (read «is equal to» or «equals») between the expressions. Thus: $5x + 7 = 32$, and $ax^2 + bx + c = 0$, are equations, each of which indicates the equality of the quantity written on the left of the sign (=) to that written on the right of the sign. Usually the object of writing down an algebraic equation is to express in symbols known relations between given and unknown quantities, so that by algebraic processes the latter may be determined in terms of the former. (See Algebra.) (2) In astronomy is the correction by addition to or subtraction from the mean motion of any heavenly body, in order to determine its true place at any given time. The mutual attraction among the planets renders each one capable of producing a perturbation in the orbits of all the others. An equation is required for every such perturbation before it is possible to calculate accurately the course of the planet. Thus we have the equation of the centre, a quantity to be added to or subtracted from the anomaly, in order to determine the true position of a heavenly body. For instance, let the curve E C F represent the earth's orbit (which is an ellipse), E F the line of the apsides, and A the position of the sun. When the earth is in any position as C, the line A C drawn from the sun to the planet is the radius vector, then will the angle C A F be the anomaly, or the angular distance from the perihelion. Were the earth's motion uniform the increase or decrease of this angle would be equal in equal times, and the mean anomaly would be the true anomaly; but the earth's motion is retarded as it advances from F to C, is slowest at E, and is accelerated from that point, the aphelion, through the other half of its orbit till it arrives at F, the perihelion. The quantity to be added to the mean angular motion, during one portion of the orbit, or subtracted from it in the other, in order to find the true anomaly, is called the equation of the centre. (3) In chemistry, is a collection of symbols to denote that two or more definite bodies — simple or compound — have been brought within



the sphere of chemical action, that a reaction has taken place, and that new bodies are produced. It is called an equation because the total weight of the substances concerned remains the same. See CHEMISTRY.

Equation, Personal, an important correction that must be considered in connection with refined measurements in astronomy and physics, and which originates in the fact that no two observers agree precisely as to the instant at which a phenomenon occurs, nor as to the setting of a micrometer-wire so as to bisect a division mark on a scale. Differences of this sort are exceedingly irregular among inexperienced observers, but among the more experienced ones the regularity, while not absolute, is strongly marked. In some kinds of work the personal equation of the observer can be eliminated by the method in which the observations are made. Thus, in the determination of differences of longitude by telegraphic methods, it is usual to eliminate the effect of personal error from the final result by having the observers change places when the work is half done; so that if the difference of longitude as determined by the first half of the work was too large, that determined during the second half will be too small by an equal amount, and the effect of personal equation will disappear from the final mean. In other cases it is impossible to eliminate the effects of personal error in any such way, and in these cases the attempt is often made to determine the magnitude of the personal equation, and apply the proper correction to the results as directly observed. Thus Otto Struve, in connection with his measurements on double stars, had artificial double stars constructed, upon which he made regular observations for the purpose of studying his personal equation in such work, and he applied, to his results for the genuine stars, a series of corrections deduced in this way. When the thing to be measured is an interval of some kind, the personal equation can usually be neglected, provided the same observer makes all the measures. For example, in determining the length of a bar, the reading of the micrometers will be in error (so far as the personal equation is concerned) by the same amount at both ends of the bar, and hence the difference of these readings; or, in other words, the observed length of the bar will be independent of the observer's personal equation.

Equations, Differential. — 1. *Introduction.*— The invention of the calculus, made necessary by the demands of natural science, was followed immediately by the most brilliant applications. The names of Newton, Leibnitz, Euler, Lagrange, and Laplace are attached to the principal discoveries of this period, whose importance from a scientific and philosophical point of view can hardly be overestimated. A simple example will suffice to explain the ruling idea of this epoch. From the observations of Tycho Brahe, Kepler had obtained the laws of planetary motion still known by his name. Newton had shown that Kepler's laws were but a consequence of the law of universal gravitation, which assumes that every particle in the universe acts upon every other according to a definite law. The effect of Newton's law upon a system of moving bodies can be formulated in mathematical symbols without any difficulty. This formulation gives rise to a system of equations involving the coordinates of the moving bodies and their accelerations, *i.e.*, the second derivatives of these coordinates with respect to the time. The problem of expressing the coordinates as functions of the time, *i.e.*, the problem of integrating this system of differential equations, was solved by Newton for the case of two mutually attracting bodies, and its solution is given precisely by Kepler's laws. Newton himself and his successors, especially Laplace and Lagrange, studied the further consequences of the law of gravitation as applied to the solar system. The accord between theory and observation became closer and closer, so that it was reasonable to suppose that the true law of nature had been found. Gradually other branches of physical science were treated in a similar way. In all cases, the fundamental laws being assumed, the mathematical formulation of the problems led to the question of integrating differential equations. It should be noted that, although in some cases this method of arriving at the formulation of the physical problems has now been abandoned, differential equations are now, more than ever, used as the expressions for the fundamental phenomena in physical science. For the applications of mathematics there is no field so important as the theory of differential equations. That the whole world is a mathematical problem was the point of view gained by Laplace, an insight gained in a different way also by Leibnitz and Spinoza. But the mathematician is more specific; we learn from him that this world-problem belongs to the domain of the theory of differential equations. Even if the details of the picture have changed, the formulation of this general idea is one of the positive achievements of the philosophical thought of the eighteenth century.

Ordinary Differential Equations. Elementary Theory.—Let y be determined as a function of x by means of an equation,

$$\phi(x, y, a) = 0, \tag{1}$$

which involves an arbitrary constant a. If x and y be interpreted as the coordinates of a point in the plane, equation (1) represents a family of curves, one curve for each value of a. By differentiation we find, from (1),

$$\frac{\partial\phi}{\partial x} + \frac{\partial\phi}{\partial y}\frac{dy}{dx} = 0. \tag{2}$$

Between these two equations a may be eliminated; the result will be an equation of the form

$$f\left(x, y, \frac{dy}{dx}\right) = 0, \tag{3}$$

free from a. Equation (3) is a *differential equation.* Since it does not contain the constant a it gives the expression of a property which is common to all of the curves of the family (1). The main object of the theory of differential equations is to invert the process which we have just carried out, *i.e.*, the equation (3) being given, the equation (1) involving an arbitrary constant, from which (3) may be derived by differentiation, is to be found. This process is known as the *integration of the differential equation.*

In general let there be given an equation of the form

$$f\left(x, y, \frac{dy}{dx}, \frac{d^2y}{dx^2}, \dots \frac{d^ny}{dx^n}\right) = 0,$$

between x, the function y of x and its derivatives up to the nth order; it is called an *ordinary differential equation of the nth order*. The adjective *ordinary* implies that y is considered as a function of only *one* independent variable x. Under certain restrictions as to the continuity of the function f (a question to which we shall recur later), it may be shown that there exists a function y of x and of n arbitrary constants which satisfies the differential equation; it is known as the *general integral of the differential equation;* the determination of this function is the object of the theory of differential equations. The equation is then said to have been integrated.

The simplest case of such a differential equation presented itself in the problem of finding the area included between a curve $y = f(x)$, the x-axis, and two ordinates erected for $x = a$ and $x = x$. The differential equation satisfied by the area z considered as function of x is

$$\frac{dz}{dx} = f(x),$$

and the area itself becomes

$$z = \int_a^x f(x)dx.$$

This simple case served as a model for the earlier investigators in this field. Confining ourselves for the moment to equations of the first order, it may be possible to reduce such an equation to the form

$$\frac{dx}{R(x)} + \frac{dy}{S(y)} = 0,$$

where $R(x)$ is a function of x, and $S(y)$ a function of y alone. The variables are then said to be *separated*, and we may write

$$\int \frac{dx}{R(x)} + \int \frac{dy}{R(y)} = c,$$

where c is an arbitrary constant. Owing to the fact, which has just been mentioned, that the problem of areas is solved by the computation of an integral of the form $\int_a^x f(x)dx$, such an integration is known as a *quadrature*. If the variables can be separated, the differential equation may, therefore, be integrated by quadratures.

The earlier analysts believed that any differential equation could be integrated by the elementary functions then in use, and by quadratures. This we now know not to be the case, just as we know, since the days of Abel, that all algebraic equations cannot be solved by the mere extraction of roots. (See ALGEBRA; THEORY OF EQUATIONS; GALOIS' THEORY.) Moreover, even if the reduction to quadratures can be effected, such a reduction is, properly speaking, the beginning and not the end of the investigation. For it does not suffice to give a formal indication of the relation between x and y; this relation must be thoroughly understood in its essential properties before the integration can be said to have been accomplished. Nevertheless the consideration of the simpler cases, in which integration by means of elementary functions or by quadratures is possible, constitutes a first important chapter of the theory of differential equations. We may characterize this chapter as the *elementary* theory of differential equations.

Elementary Theory of Differential Equations.— We have already referred to the case in which the variables are separated. In many cases a simple transformation will accomplish the separation. Consider, for example, the equation

$$(4) \qquad \frac{dy}{dx} + Py = 0,$$

where P is a function of x only. We may write

$$\frac{dy}{y} + Pdx = 0,$$

whence

$$\log y + \int Pdx = \log c,$$

or

$$(5) \qquad y = ce^{-\int Pdx}.$$

This example will be useful in enabling us to treat, at once, a more general equation; we shall do so, moreover, by making use of a method frequently employed, and especially important in the applications to theoretical astronomy, the method of *variation of constants*. We consider the equation

$$(6) \qquad \frac{dy}{dx} + Py = Q,$$

where P and Q are functions of x only. This equation is the most general linear differential equation of the first order, a linear equation being one which contains y and its derivatives in no higher than the first power. Equation (6) differs from (4) only in having Q in the right member in place of zero. The expression (5) will certainly not satisfy (6) since it satisfies (4). Clearly, however, it must be possible to satisfy (6) by an expression of the form analogous to (5), viz.,

$$(7) \qquad y = ue^{-\int Pdx},$$

where u is a properly chosen function of x instead of being a constant. Moreover, as we shall see, we can actually determine the function u by quadratures. In fact, we find from (7)

$$\frac{dy}{dx} = \left(\frac{du}{dx} - Pu\right) e^{-\int Pdx},$$

which gives, on substitution into (6)

$$\frac{du}{dx} = Qe^{\int Pdx},$$

so that we shall have

$$(8) \qquad y = e^{-\int Pdx}\left[C + \int Qe^{\int Pdx} dx\right],$$

as the general integral of (6). This formula was found by Jacob Bernoulli, who also showed that the equation

$$(9) \qquad \frac{dy}{dx} + Py = Qy^{-m+1}$$

could be reduced to (6) by putting $u = y^m$.

The *homogeneous* equations of the form

$$(10)\qquad \frac{dy}{dx} = \phi\left(\frac{y}{x}\right),$$

where $\phi\left(\frac{y}{x}\right)$ depends only upon the ratio of y to x, may also be solved by quadratures. In fact, if we put $y = vx$, the equation becomes

$$\frac{dx}{x} + \frac{dv}{v - \phi(v)} = 0,$$

whence

$$(11)\qquad \log x + \int \frac{dv}{v - \phi(v)} = c.$$

Euler's method of the *integrating factor* is sometimes useful. It rests upon the following considerations. Let $\phi(x, y) = \text{const.}$ be the equation of any integral curve of the equation

$$(12)\qquad P(x, y)dx + Q(x, y)dy = 0.$$

We shall have, by differentiation from $\phi(x, y) = \text{const.}$,

$$\frac{\partial\phi}{\partial x}dx + \frac{\partial\phi}{\partial y}dy = 0,$$

an equation which must have the same significance as (12). We must, therefore, have

$$(13)\qquad \mu P(x, y) = \frac{\partial\phi}{\partial x}, \quad \mu Q(x, y) = \frac{\partial\phi}{\partial y},$$

if μ is a properly chosen function of x and y. If μ is known, the determination of ϕ by quadratures can be immediately accomplished on account of the two equations (13). For this reason μ is called an integrating factor. Equations (13) show that μ must satisfy the partial differential equation

$$(14)\qquad \frac{\partial(\mu P)}{\partial y} - \frac{\partial(\mu Q)}{\partial x} = 0.$$

In general, the determination of an integrating factor is just as difficult as the integration of the equation. But Euler succeeded in finding a number of equations with known integrating factors. Herein lies the value of the method.

By means of these various methods there was obtained in the course of time a considerable number of equations which could be integrated by quadratures. Lie showed that this rather scrappy theory could be understood as the consequence of a single principle. This we shall now proceed to explain, making use of geometric images for the sake of clearness as well as brevity.

The equations

$$x_1 = \phi(x, y), \quad y_1 = \psi(x, y),$$

are said to constitute a *transformation* of the point (x, y) into the point (x_1, y_1) if they can be solved for x_1 and y_1.

These equations may contain a certain number of arbitrary constants $a_1, \ldots a_r$; they are then said to constitute an r-parameter family of transformations. Let us consider the simplest case of a one-parameter family which we may write

$$(15)\qquad x_1 = \phi(x, y;\ a), \quad y_1 = \psi(x, y;\ a).$$

If the parameter a has a definite value, this transformation converts every point (x, y) into a definite other point (x_1, y_1). Let us transform this new point (x_1, y_1) by equations of the *same* form, but with a different parameter b, into a third point (x_2, y_2), so that we shall have

$$(16)\qquad x_2 = \phi(x_1, y_1;\ b), \quad y_2 = \psi(x_1, y_1;\ b).$$

In general, if we eliminate x_1, y_1 between (15) and (16) we shall find x_2 and y_2 as functions of x, y, a, and b. It *may* happen that these functions assume the form

$$(17)\qquad x_2 = \phi(x, y;\ c), \quad y_2 = \psi(x, y;\ c),$$

where c is a function of a and b, and where the functions ϕ and ψ are the *same* as in (15) and (16). If this is the case, the transformations (15) are said to form a one-parameter *group*. The one-parameter family of transformations (15) then has the property that the transformation, obtained by combining any two of its transformations, is itself a member of the family. It is for this reason that the family is then called a *group*. (See GROUPS, THEORY OF.) It is obvious how this definition may be extended to cover r-parameter groups.

The one-parameter group (15) will contain, in general, the identical transformation; *i.e.*, for a certain value a_0 of a (15) will reduce to $x_1 = x$, $y_1 = y$. If now we denote by δt an infinitesimal, and put in (15) $a = a_0 + c\delta t$, we shall find a transformation which transforms (x, y) into a point (x_1, y_1) such that the differences $x_1 - x = \delta x$ and $y_1 - y = \delta y$ will be infinitesimals of the order of δt. This will be true unless certain exceptional cases arise which we need not, at present, discuss. From every one-parameter group we may deduce in this way an *infinitesimal transformation*, and Lie has shown that conversely every infinitesimal transformation determines a one-parameter group. There is a similar connection between an r-parameter group and a corresponding set of r infinitesimal transformations, between which certain relations must then be satisfied.

A one-parameter group always has an *invariant; i.e.*, there exists a function $\Omega(x, y)$ such that, for all transformations (15) of the group, $\Omega(x_1, y_1) = \Omega(x, y)$. Such a function is said to *admit* the one-parameter group of transformations. It admits, in particular, the infinitesimal transformation of the group. Similarly, a differential equation may admit one or more infinitesimal transformations. Lie has shown that in the cases in which the variables may be separated, *i.e.*, in which integration by quadratures is possible, it is possible to write down infinitesimal transformations which leave the equations invariant. He has developed a general theory showing what advantage is gained for the integration of a differential equation by the knowledge that it admits one or more infinitesimal transformations. Let us remark, explicitly, that this theory is not confined to equations of the first order nor even to ordinary differential equations.

Before passing to the consideration of the elementary theory of equations of higher order, we proceed to explain the important notion of *singular solution*. Geometrically, an equation of the first order $\frac{dy}{dx} = \phi(x, y)$ determines the tangent of an integral curve at every point of the plane. If we start from any point P, the tangent of the integral curve passing through that point is completely determined. We follow the direction thus indicated for an infinitesimal distance to the point $(x+\delta x, y+\delta y)$. At this point the tangent is again given by the differential equation, etc. We obtain in this way, synthetically, the family of integral curves, say $F(x, y, c) = 0$. Any one of these curves is obtained by giving a definite value to the constant of integration c. The envelope of this system of curves, however, will also be a solution of the differential equation. For it will also be a curve whose tangent satisfies the requirements of the equation. But, in general, the envelope will not be itself a member of the family of curves, *i.e.*, it will not be possible to find its equation by giving a special value to c. The envelope is then said to give a singular solution of the equation. If it exists, it may be found without any integration, that is to say, without a knowledge of the general integral of the differential equation.

The most important case of a differential equation of a higher order, which may be treated by elementary methods, is that of the linear homogeneous differential equation of the nth order with constant coefficients. A linear homogeneous differential equation of the nth order has the form

$$(18)\qquad \frac{d^n y}{dx^n}+p_1\frac{d^{n-1}y}{dx^{n-1}}+\dots+p_n y=0.$$

If $y_1, y_2, \dots, y_n$ are particular solutions of the equation, $y=c_1y_1+c_2y_2+\dots+c_ny_n$, where $c_1, \dots c_n$ are constants, is also a solution. Moreover, if $y_1, \dots y_n$ are linearly independent, *i.e.*, if they satisfy no relation of the form $\gamma_1y_1+\gamma_2y_2+\dots+\gamma_ny_n=0$, where $\gamma_1, \dots \gamma_n$ are constants, the above expression for y is the general solution. $y_1, \dots y_n$ are then said to constitute a *fundamental system* of solutions. In the case that $p_1, \dots p_n$ are constants a fundamental system may be easily obtained. In fact we find that $y=e^{\rho x}$ is a solution of (18) if ρ is a root of the equation

$$\rho^n+p_1\rho^{n-1}+\dots+p_{n-1}\rho+p_n=0.$$

Moreover, if $\rho_1, \dots \rho_n$ are the roots, supposed distinct, of this equation, $e^{\rho_1 x}, e^{\rho_2 x}, \dots e^{\rho_n x}$ actually form a fundamental system. If λ roots, say $\rho_1, \rho_2, \dots \rho_\lambda$, coincide, the λ identical functions $e^{\rho_1 x}, \dots e^{\rho_\lambda x}$ are replaced by $e^{\rho_1 x}$, $xe^{\rho_1 x}$, $x^2e^{\rho_1 x}, \dots x^{\lambda-1}e^{\rho_1 x}$.

Total Differential Equations.—In the case of an equation between two variables which we have considered so far, one important distinction, which we shall now have to make, has not been necessary. If $P(x, y)dx+Q(x, y)dy=0$ is such an equation, it is always possible to find a single function $\phi(x, y)$ such that $\phi(x, y)=\text{const.}$ shall represent the general integral. Either the expression $Pdx+Qdy$ is the complete differential of $\phi(x, y)$ so that $P=\frac{\partial\phi}{\partial x}$ and $Q=\frac{\partial\phi}{\partial y}$, or else upon multiplication with Euler's integrating factor $\mu(Pdx+Qdy)$ becomes such a complete differential. This is not the case when there are more than two variables. Consider such an equation in three variables,

$$(19)\qquad Pdx+Qdy+Rdz=0,$$

where P, Q, R are functions of x, y, and z. For the sake of symmetry assume that x, y, z are regarded as functions of a fourth variable t. The problem before us is to find all sets of functions x, y, z of t which will satisfy (19). It *may* happen that the left member of (19) becomes a complete differential upon multiplication with a function μ of x, y, z, so that

$$\mu P=\frac{\partial\phi}{\partial x},\quad \mu Q=\frac{\partial\phi}{\partial y},\quad \mu R=\frac{\partial\phi}{\partial z}.$$

The elimination of μ from these three equations shows that this can be the case only if P, Q, R satisfy the so-called integrability condition:

$$(20)\qquad P\left(\frac{\partial Q}{\partial z}-\frac{\partial R}{\partial y}\right)+Q\left(\frac{\partial R}{\partial x}-\frac{\partial P}{\partial z}\right)+R\left(\frac{\partial P}{\partial y}-\frac{\partial Q}{\partial x}\right)=0.$$

Moreover it may be shown that if P, Q, R satisfy this condition, there exists a function $\phi(x, y, z)$ and an integrating factor $\mu(x, y, z)$ such that

$$\mu(Pdx+Qdy+Rdz)=d\phi,$$

so that integration of (19) will give the result $\phi(x, y, z)=\text{const.}$ But if (20) is not satisfied, no integration of (19) in this sense is possible. The reason for this distinction as well as the discussion of the non-integrable case will be clearly understood if we make use of a geometric interpretation. Let x, y, z be Cartesian coordinates of a point in space. If x, y, z are known as functions of t, there will be determined a certain space-curve. It is our problem to determine such space-curves

$$x=f(t),\quad y=g(t),\quad z=h(t)$$

as satisfy (19). Through every point (x_0, y_0, z_0) of space there may be drawn an infinity of such curves. The tangents of all of these curves which pass through the point (x_0, y_0, z_0) form a plane pencil with (x_0, y_0, z_0) as vertex, and the plane

$$P(x_0, y_0, z_0)(x-x_0)+Q(x_0, y_0, z_0)(y-y_0)+R(x_0, y_0, z_0)(z-z_0)=0$$

as plane. Thus there is for every point P a plane p containing P, to which all of the integral curves of (19) which pass through P must be tangent. We may now imagine an integral curve of (19) constructed as follows: Start from a given point P and construct the corresponding plane p. We go from P to a point Q infinitesimally close to P but otherwise arbitrarily situated in the plane p. At Q we construct the plane q corresponding to it, and in this plane we pick out a point R infinitesimally close to Q. Proceeding in this way we gradually build up an integral curve. It may happen that *all* of the integral curves of (19) which pass through the point P are situated upon a certain surface S. If this is the case for all points P, the integrability condition is satisfied; there exists a single infinity of surfaces $\phi(x, y, z)=c$, such that an arbitrary curve upon each of these surfaces satisfies the differential equation. In general, however, such a family of surfaces does not exist. We may then integrate (19) as follows: Take an *arbitrary* surface $\psi(x, y, z)=0$. Let P be any point upon it. Let p be the plane of the pencil of directions which the differential equation assigns to P, and let p' be the plane tangent to the surface $\psi(x, y, z)=0$ at P. The intersection t of p and p' will be at the same time tangent to an integral curve of (19) and tangent to the surface $\psi=0$. From P we go along t to a point Q infinitesimally close to P and there repeat this process. We may build up in this way all of the integral curves of (19) which are situated upon an arbitrary surface. Upon every arbitrary surface there will be a single infinity of such curves. Analytically this process may be carried out as follows: From $\psi=0$ we find

$$\frac{\partial\psi}{\partial x}dx+\frac{\partial\psi}{\partial y}dy+\frac{\partial\psi}{\partial z}dz=0.$$

From this equation and $\psi=0$, dz and z may be expressed in terms of x, y, dx, and y. Substitution of these values into (19) gives rise to an equation of the form

$$M(x,y)dx+N(x,y)dy=0,$$

which may be integrated in the form $\phi(x,y)=c$. This latter equation together with $\psi(x,y,z)=0$ gives the required solution. By giving all possible forms to the functions ψ all possible solutions will be obtained.

Similar considerations are necessary in the general case of n variables. The first considerable contribution to this theory is due to Pfaff. For this reason such an equation is known as a *Pfaffian equation*, and the problem of its integration as *Pfaff's problem*. The problem leads to a system of no more than n integral equations when the number of variables is $2n$ or $2n-1$. If the equations are of higher than the first degree in the differentials, Lie speaks of them as *Monge equations*. Many problems of differential geometry, especially in relation to the theory of complexes, are connected with Pfaffian and Monge equations.

Partial Differential Equations.—Frequently functions of several variables are defined by relations between those functions and their partial derivatives. Such equations are called partial differential equations. For the sake of simplicity we will confine ourselves to the case of a single unknown function, and for the most part to the case of two independent variables. As in the case of ordinary differential equations, it will be instructive to see first how such equations may arise as the result of elimination of arbitrary elements from equations which do not involve the derivatives. Let z be given as a function of x, y and of the two arbitrary constants a, b by the equation

$$f(x,y,z;\ a,b)=0. \tag{21}$$

Let p, q represent $\frac{\partial z}{\partial x}$ and $\frac{\partial z}{\partial y}$ respectively. Then differentiation will give

$$\frac{\partial f}{\partial z}p+\frac{\partial f}{\partial x}=0,\quad \frac{\partial f}{\partial z}q+\frac{\partial f}{\partial y}=0. \tag{22}$$

Between the three equations (21) and (22) a and b may be eliminated. Let

$$F(p,q;\ x,y,z)=0 \tag{23}$$

be the result of this elimination. It is the partial differential equation which corresponds to (21); (21) is called the *complete* integral of (23).

But a and b in (21) may be functions of x, y and still the result of the elimination may be the same equation (23). In fact we find from (21), assuming that a and b are functions of x and y,

$$\frac{\partial f}{\partial z}p+\frac{\partial f}{\partial x}+\frac{\partial f}{\partial a}\frac{\partial a}{\partial x}+\frac{\partial f}{\partial b}\frac{\partial b}{\partial x}=0,$$
$$\frac{\partial f}{\partial z}q+\frac{\partial f}{\partial y}+\frac{\partial f}{\partial a}\frac{\partial a}{\partial y}+\frac{\partial f}{\partial b}\frac{\partial b}{\partial y}=0,$$

which equations will reduce to (22), and therefore give rise to the same equation (23), if

$$\frac{\partial f}{\partial a}\frac{\partial a}{\partial x}+\frac{\partial f}{\partial b}\frac{\partial b}{\partial x}=0,\quad \frac{\partial f}{\partial a}\frac{\partial a}{\partial y}+\frac{\partial f}{\partial b}\frac{\partial b}{\partial y}=0. \tag{24}$$

Let the determinant of these equations be denoted by Δ, so that

$$\frac{\partial a}{\partial x}\frac{\partial b}{\partial y}-\frac{\partial a}{\partial y}\frac{\partial b}{\partial x}=\Delta;$$

then we may write, in place of (24), the equivalent equations

$$\Delta\frac{\partial f}{\partial a}=0,\quad \Delta\frac{\partial f}{\partial b}=0. \tag{24a}$$

If $\Delta\neq 0$, we must therefore have

$$\frac{\partial f}{\partial a}=0,\quad \frac{\partial f}{\partial b}=0.$$

From these equations a and b may be obtained as functions of x and y; if these values are substituted in (21), a function z of x and y is obtained, independent of any arbitrary constants, but still a solution of the partial differential equation (23). This solution is called a *singular* integral of (23). It may or may not be a special case of the complete integral.

Equations (24a) are also satisfied if $\Delta=0$, *i.e.*, if

$$b=\phi(a), \tag{25}$$

where $\phi(a)$ denotes an arbitrary function of a. If we multiply the left members of (24) by dx and dy respectively, and add, we find

$$\frac{\partial f}{\partial a}da+\frac{\partial f}{\partial b}db=0,$$

whence, since $db=\phi'(a)da$,

$$\frac{\partial f}{\partial a}+\frac{\partial f}{\partial b}\phi'(a)=0. \tag{26}$$

If we eliminate a and b from the equations (21), (25), and (26), we find z as a function of x and y, the expression of which depends upon the arbitrary function ϕ. Moreover this function z will again be a solution of (23). It is known as the *general integral*, and involves an arbitrary function. It may be shown that every integral of such a partial differential equation belongs to one of these three classes.

Geometrical interpretation will again render the matter perfectly clear. Let x, y, z be coordinates of a point in space; (21) will represent a two-parameter family of surfaces, or, as we may say, a family of ∞^2 surfaces. The equation of the plane tangent to one of these surfaces at a point (x, y, z) will be

$$\zeta-z=p(\xi-x)+q(\eta-y).$$

For a fixed value of x, y, z, (23) gives therefore an infinity of planes through that point (enveloping a cone); any integral surface of (21), which passes through that point, must have one of these planes as its tangent plane. In other words, the differential equation determines a certain cone corresponding to every point of space, and with this point as vertex;

an integral surface must be tangent at each of its points to the corresponding cone. Now let a complete solution of the equation be given, so that we know a family of ∞^2 surfaces each of which fulfills the requirements of the problem. If we put $b=\phi(a)$, where $\phi(a)$ is any function of a, we obtain a one-parameter family of surfaces included among the ∞^2 surfaces just mentioned. The envelope of this one-parameter family is given by the general integral. The singular integral is the envelope of all of the ∞^2 surfaces of the complete integrals, provided that such an envelope exists.

Since the surface represented by the general integral is the envelope of a single infinity of surfaces represented by the complete integral, each of these latter surfaces will touch the former along a certain curve; such a curve is known as a *characteristic*. If the partial differential equation is not linear in $\frac{\partial z}{\partial x}$ and $\frac{\partial z}{\partial y}$, there are ∞^3 characteristics. A linear equation has only ∞^2 characteristics. The integral surfaces may be looked upon as generated by characteristics, and the usual method of integrating the partial differential equation consists in setting up a system of ordinary differential equations which determines the characteristics.

The Points of View in the Higher Theory.—In speaking of ordinary differential equations, we have already mentioned the fact that the point of view of the elementary theory is inadequate even in those cases in which the reduction to quadratures is possible. Given, for example, the equation

$$\left(\frac{dy}{dx}\right)^2=(1-y^2)(1-k^2y^2),$$

which may be reduced to a quadrature;

$$x=\int\frac{dy}{\sqrt{(1-y^2)(1-k^2y^2)}}.$$

The reduction of the equation to this form is a mere formal process which, in itself, teaches us nothing. We shall have to ask ourselves the following questions: to what extent does a given differential equation define a function y of x? what are the characteristic properties of this function? what analytical processes involving known functions, infinite series, products, etc., will serve for the computation of the values of the function for all of the values of its argument? In the case of the above differential equations these questions have been completely answered by the creation of the theory of elliptic functions by Abel and Jacobi. In general it is to be expected that every differential equation defines a transcendental function; it is the theory of these transcendentals which constitutes properly the most important portion of the theory of differential equations.

In order fully to understand the properties of functions it has been found necessary to look upon the variable as being capable of assuming not only all real but also all complex values. In the hands of Cauchy, Riemann, Weierstrass there has grown up in this way the *theory of functions of a complex variable* (q.v.). This theory serves as a base for our further discussions. We shall, however, confine ourselves to a few of the simplest cases, merely indicating the general point of view.

Let

$$\frac{dy}{dx}=f(x, y)$$

be the given differential equation. Let $f(x, y)$ be analytic in the vicinity of (x_0, y_0), *i.e.*, let it be possible to develop $f(x, y)$ into a series proceeding according to positive integral powers of $x-x_0$ and $y-y_0$. Then, as was first proved by Cauchy, there exists a function y of x which may be developed according to positive integral powers of $x-x_0$, which reduces to $y=y_0$ for $x=x_0$, and which satisfies the differential equation. This theorem, which may be easily generalized to apply to equations of higher order, or to systems of equations of the first order, is generally known as the fundamental theorem of the theory of differential equations. It proves the existence of analytic functions which are uniquely defined as solutions of analytic differential equations and which satisfy the subsidiary condition of reducing to given values for a given value of the argument. The theorem may be proved by the so-called "Calcul des limites." This consists in finding a series which formally satisfies the differential equation and reduces to y_0 for $x=x_0$; its convergence is then demonstrated by comparing it term for term with a corresponding series, which is formed in the same way from another differential equation, and which is known to be convergent. The exact circle of convergence cannot, however be generally stated. A great many papers have been written on questions which easily suggest themselves in connection with this theorem. If the function $f(x, y)$ is not developable in the given form; if, for example, its development contains negative or fractional exponents, how far are its solutions determined and what is the form of their developments? Besides the analytic solutions whose existence Cauchy has demonstrated, are there other non-analytic solutions? The first investigations of these equations are due to Briot and Bouquet. They have since been completed by a great many authors.

Cauchy's existence theorem can be made more precise in the case of *linear* differential equations. Let

$$(27)\qquad \frac{d^ny}{dx^n}+p_1\frac{d^{n-1}y}{dx^{n-1}}+\dots+p_ny=0$$

be a homogeneous, linear differential equation of the nth order. In the vicinity of $x=x_0$ let the coefficients p_k be expressible as power-series, proceeding according to positive integral powers of $x-x_0$, and convergent for all values of x for which $|x-x_0|<r$, where r is a real positive quantity, *i.e.*, for all points of the plane of the complex variable which are within a circle of radius r and of center x_0. Then, there exists a function y of x, expressible as a power series convergent in the *same* domain, which satisfies the differential equation, and which, together with its first $n-1$ derivatives, assumes arbitrarily prescribed values for $x=x_0$.

The proof of this theorem, due to Fuchs, is also based on the "calcul des limites." The important point is the fact that the true radius of convergence of the series is determined by inspection from the differential equation itself. The existence of a fundamental system of solutions expressible by power-series follows at once.

Let $y_1, \ldots y_n$ be the members of such a fundamental system. Let $a_1, \ldots a_m$ be the singular points (poles) of the coefficients $p_1, \ldots p_n$ which we shall assume to be rational functions of x. Let $y_1, \ldots y_n$ be continued analytically along a path passing, in the positive direction, around one of these singular points a, and let $\bar{y}_1, \ldots \bar{y}_n$ be the new branches of the functions $y_1, \ldots y_n$ which are thus defined by power-series in the vicinity of $x=x_0$ after this process. We must have

$$(28)\quad \bar{y}_\kappa = \alpha_{\kappa 1} y_1 + \alpha_{\kappa 2} y_2 + \ldots + \alpha_{\kappa n} y_n, \quad (\kappa = 1, 2, \ldots n),$$

where $\alpha_{\kappa i}$ are constants, since $\bar{y}_1, \ldots \bar{y}_n$ must constitute again a system of solutions (moreover a fundamental system). A new fundamental system may be chosen in the following manner. Put

$$z = c_1 y_1 + c_2 y_2 + \ldots + c_n y_n,$$

where $c_1, \ldots c_n$ are constant coefficients. After the continuation around a, z will be changed into

$$\bar{z} = c_1(\alpha_{11} y_1 + \ldots + \alpha_{1n} y_n) + \ldots \\ + c_n(\alpha_{n1} y_1 + \ldots + \alpha_{nn} y_n).$$

This will be equal to ωz, where ω is a constant, if

$$(29)\quad \begin{array}{l} c_1(\alpha_{11} - \omega) + c_2\alpha_{21} + \ldots + c_n\alpha_{n1} = 0, \\ c_1\alpha_{12} + c_2(\alpha_{22} - \omega) + \ldots + c_n\alpha_{n2} = 0, \\ \cdot \quad \cdot \quad \cdot \quad \cdot \quad \cdot \\ c_1\alpha_{1n} + c_2\alpha_{2n} + \ldots + c_n(\alpha_{nn} - \omega) = 0, \end{array}$$

whence

$$(30)\quad F(\omega) = \begin{vmatrix} \alpha_{11} - \omega, & \alpha_{21}, & \ldots & \alpha_{n1} \\ \alpha_{12}, & \alpha_{22} - \omega, & \ldots & \alpha_{n2} \\ \cdot & \cdot & \cdot & \cdot \\ \alpha_{1n}, & \alpha_{2n}, & \ldots & \alpha_{nn} - \omega \end{vmatrix} = 0.$$

If ω_1 is a root of (30), and the ratios of $c_1, \ldots c_n$ are determined from (29) after ω has been put equal to ω_1, we shall therefore find a solution z_1 of (27) which changes into $\omega_1 z_1$ when the variable x describes a closed path around the singular point considered. If the equation $F(\omega)=0$ has n distinct roots, we shall find n such solutions, and we may write

$$(31)\quad \bar{z}_i = \omega_i z_i, \quad (i = 1, 2, \ldots n)$$

in place of (28). Moreover these n solutions $z_1, \ldots z_n$ will constitute a fundamental system. We shall not attempt to discuss the case of coincident roots of the equation (30), which is known as the *fundamental* or *characteristic* equation.

Now the function

$$(x-a)^{r_i} = e^{r_i \log (x-a)}, \quad r_i = \frac{1}{2\pi i} \log \omega_i$$

has precisely the same property. Therefore the quotient $\dfrac{z_i}{(x-a)^{r_i}}$ is a function uniform in the vicinity of $x=a$, and therefore expressible by a so-called Laurent series proceeding according to positive and negative but integral powers of $x-a$. Let $\phi_i(x)$ be such series; then we have

$$(32)\quad z_i = (x-a)^{r_i} \phi_i(x), \quad (i = 1, 2, \ldots n).$$

The Laurent series will be convergent for all points, excepting a itself, of the circle which has a as center and which reaches up to the nearest singular point of the differential equation. The main questions to solve are: 1st. Determine the exponents r_i; 2d. Find the coefficients of the Laurent series ϕ_i. These questions are capable of a direct and general solution in the special case in which the Laurent series contains only a finite number of terms involving negative powers of $x-a$. In that case the differential equation (27) may be written in the form

$$(33)\quad \frac{d^n y}{dx^n} + \frac{P_1(x)}{x-a}\frac{d^{n-1}y}{dx^{n-1}} + \frac{P_2(x)}{(x-a)^2}\frac{d^{n-2}y}{dx^{n-2}} + \ldots \\ + \frac{P_n(x)}{(x-a)^n} y = 0,$$

where $P_1, P_2, \ldots P_n$ are expressible as power-series proceeding according to *positive*, integral powers of $x-a$. The exponents r_i are then the roots of the *determinating fundamental equation* of the nth degree

$$(34)\quad r(r-1)\ldots(r-n+1) + P_1(a) r(r-1) \ldots \\ (r-n+2) + \ldots + P_n(a) = 0.$$

After r_i has been obtained from this equation, the method of indeterminate coefficients enables one to find the coefficients of the power-series. In the case of equal roots some of the solutions may contain such terms as $\log (x-a)$, $\{\log (x-a)\}^2$, etc.; the general discussion of the various cases which may arise is rather complicated.

The case in which the equation may be written in the form (33) is usually described as that in which the solutions are *regular* about $x=a$. If they are regular in the vicinity of each singular point, including $x=\infty$, the equation is said to be of the *Fuchsian type*, and may be written as follows:

$$(35)\quad y^{(n)} + \frac{G_{\rho-1}}{\phi} y^{(n-1)} + \frac{G_{2(\rho-1)}}{\phi^2} y^{(n-2)} + \ldots \\ + \frac{G_{n(\rho-1)}}{\phi^m} y = 0,$$

where y', y'', etc., denote the derivatives of y of the first, second order, etc., where

$$(35a)\quad \phi = (x-a_1)(x-a_2) \ldots (x-a_m),$$

$a_1, \ldots a_m$ and ∞ being the singular points, and where G_λ denotes a polynomial in x of degree no higher than λ. The most important special case of such an equation is that of the hypergeometric series, the so-called Gauss equation, which is of the second order and has three singular points, 0, 1, and ∞. Historically, the theory of the Gauss equation, as treated by Riemann, was the origin of the general theory of linear differential equations. A large number of the most important conceptions of the theory of functions are closely connected with this equation. The question of finding the cases in which the general solution is algebraic led Schwarz, Fuchs, and Klein to the remarkable algebraic functions which are connected with the five regular solids. This equation also leads to the general theory of automorphic functions, of which the elliptic functions are a special case.

If, in the vicinity of a singular point, the solutions are regular, they may be developed in series whose coefficients may be determined in the manner indicated. The problem of finding the developments of the solutions in the vicinity of a point where they are not regular is far more difficult and still awaits a satisfactory general solution. A solution, not regular at $x=a$, may have the special form

$$e^{\Omega}(x-a)^{\rho}\,\psi(x),$$

where ρ is a constant, where $\phi(x)$ is an ordinary power-series in $x-a$, and where

$$\Omega = \frac{a_1}{(x-a)^s} + \frac{a_2}{(x-a)^{s-1}} + \dots + \frac{a_s}{x-a},$$

so that it differs from a regular integral only by the presence of the factor e^{Ω}. Such an integral, if it exists, is called a *normal integral*. There may also be integrals of a similar form in which, however, $(x-a)^{1/k}$ appears in place of $x-a$, where k is a positive integer. They are called *subnormal*. The conditions for the existence of normal and subnormal integrals have been investigated, but none of these investigations is as yet in a final form. Moreover these normal and subnormal integrals are clearly nothing but very special examples of non-regular integrals. A general theory on such a basis requires a systematic and complete theory of essential singular points of uniform functions of a complex variable. Such a theory, however, does not exist.

It becomes necessary, therefore, to change the method of attack. The general theory shows that, in the vicinity of the singular point $x=a$, a solution exists of the form $(x-a)^{\rho}\phi(x)$, where $\phi(x)$ is, in general, a Laurent series. The question is this: how to determine the exponent ρ and the coefficients of $\phi(x)$. In the regular case, when $\phi(x)$ is an ordinary power-series, substitution of this expression into the differential equation, and comparison of powers of $x-a$, solves the problem. One may do the same thing in general. But then one finds it necessary to solve a system of linear equations infinite in number and with an infinity of unknown quantities. This leads to the notion of *infinite determinants*, due primarily to G. W. Hill. Hill applied infinite determinants just as though they were finite, paying no attention to convergence or rigorous definitions. This deficiency was made up and the whole theory placed upon a solid basis by Poincaré and Koch.

The theory of linear differential equations has served as a basis for practically all that is known about non-linear equations. There are two fundamental properties of the linear equations which render them peculiarly accessible. In the first place it is known, *a priori*, how the arbitrary constants enter into the expression of its general integral; in the second place the singular points of its solutions are *fixed*, *i.e.*, independent of the constants of integration. Other classes of differential equations may be defined which have one or both of these properties. The first-mentioned point of view leads to the differential equations with fundamental solutions. These may be defined in various ways, and have been investigated by Guldberg, Vessiot, Lie, and Wilczynski. The idea of investigating the differential equations with fixed branch-points is due to Fuchs. For equations of the first order he succeeded in formulating the conditions in a very simple theorem. Poincaré then showed that all such equations can be transformed into a Riccati equation, *i.e.*, an equation of the form

$$(36)\qquad \frac{dy}{dx} = a_0 + a_1 y + a_2 y^2,$$

where a_0, a_1, a_2 are functions of x, or else are integrable by quadratures or algebraic functions. Differential equations of the first order with fixed branch-points do not, therefore, as was at first expected, lead to new transcendental functions. For, the Riccati equation may, by the transformation $y = -\frac{1}{a_2 z}\frac{dz}{dx}$, be converted into a linear differential equation of the second order. It may be noted, incidentally, that this remark enables us to prove, in a simple manner, the theorem that the anharmonic ratio of any four solutions of a Riccati equation is constant. This is important in geometric applications.

The most important recent investigations in the theory of differential equations, from the standpoint of the theory of functions of a complex variable, are due to Painlevé. A brief account of some of them will indicate their fundamental nature. Let

$$(37)\qquad \frac{dy}{dx} = f(x, y)$$

be an algebraic differential equation of the first order. The general integral will be a function of x and u, u being the constant of integration. We may, instead, consider u as a function of x and y defined by the partial differential equation

$$(38)\qquad \frac{\partial u}{\partial x} + \frac{\partial u}{\partial y}f(x, y) = 0.$$

The general integral of (37) is said to be *reducible* if other equations, algebraic in x, y, u, $\frac{\partial u}{\partial x}$, $\frac{\partial u}{\partial y}$, $\frac{\partial^2 u}{\partial x^2}$, etc., may be adjoined to (38) compatible with it without being deducible therefrom. All of the equations of the first order which have been studied are reducible in this sense; for instance, the Riccati equation, the linear equation, etc. In the case of a linear equation the condition $\frac{\partial^2 u}{\partial y^2} = 0$ may be thus adjoined; if the equation admits an algebraic integrating factor λ, we may adjoin the condition $\frac{\partial u}{\partial y} = \lambda$; etc. This definition of reducibility may be extended to equations, or systems of equations, of any order.

Applied to equations of the first order, the following theorem results. If an equation of the first order is reducible, only four cases are possible: 1st, the equation is algebraically integrable; 2d, it has an algebraic integrating factor; 3d, the logarithm of the integrating factor has algebraic first derivatives; 4th, a first integral is given by a system of differential equations whose general solution is of the form $u = \frac{au_1 + b}{cu_1 + d}$, ($a$, b, c, d being arbitrary constants,) and which may be reduced to a Riccati equation.

Irreducible equations of the first order lead to known results, if we confine ourselves to the case that y shall be a uniform function of x. This is not the case, however, for equations of higher order. Among the equations of the second order, the simplest case is that of the equation

$$(39)\qquad y'' = 6y^2 + x.$$

Its general integral is a uniform function of x, which may be represented as a quotient of two integral transcendental functions in the form $y = \frac{d^2 \log u}{dx^2}$, where u is an integral transcendental function which satisfies the equation

$$\frac{1}{2}(z'')^2+2(z')^3+xz'-z=0, \tag{40}$$

where $z=\frac{u'}{u}$, and which may, therefore, be represented by an ordinary power-series convergent for all values of x.

Although great progress has been made in this direction, and although greater progress is to be expected as the efforts of mathematicians are being gradually rewarded, the results are meager from the point of view of the mathematical physicist, who would like to refer to the mathematician the questions connected with the integration of a differential equation which may have appeared in some of his investigations. For, very rarely will it happen that such an equation belongs to one of the classes with which the mathematician is prepared to deal. It remains necessary to study such equations directly by methods of successive approximation especially adapted to them, usually upon the assumption that all of the variables that enter be confined to real values. The restriction to real variables in such cases, the systematic and rigorous application of the method of successive approximations, has been productive of many valuable results in recent years, especially in the hands of Picard and Hilbert. The theory of partial differential equations, primarily, has made rapid progress through their efforts, and many mathematicians are following their example. It may, however, be predicted that, even in the theory of partial differential equations, the restriction to real variables will gradually pass away. For, in the case of analytic functions, and these after all are the most important, the characteristic properties are veiled by such a restriction. But a necessary prerequisite for a theory of partial differential equations with complex variables is the theory of functions of several complex arguments; this theory, however, is still in its infancy.

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Equations, Galois' Theory of.—In the 16th century the Italian mathematicians succeeded in solving the cubic and biquadratic equations. Their brilliant achievements must have made it seem probable that the solution of the equations of fifth and higher degrees would soon be found. Such, however, was not to be the case. For two centuries the first mathematicians of the day essayed in vain to solve the quintic. Tschirnhaus, Euler, Vandermonde, Malfatti, and Lagrange have embodied their researches in valuable memoirs, but at the close of the 18th century the solution of the equation of fifth degree seem farther away than ever.

In their apparent defeat, however, lay the germs of ultimate victory. As a result of all these investigations it became manifest that the solution of algebraic equations and certain groups of substitutions of their roots were intimately related. In the case of the general equations of degrees three and four this relation was very clear indeed; it was less clear in regard to the general equation of degree n, and still more hazy in regard to the special equations which had been considered up to that time. It was reserved to Evareste Galois to put these loose ends together and to develop a theory of the solution of algebraic equations at once simple and far-reaching. Indeed, the ideas of Galois are not only fundamental in most algebraic investigations, but they have also been extended by Lie and others with great effect to the theory of differential equations. But even here they do not stop. It is in Galois' theory that the notion of a group first came prominently before the mathematical public; a notion which to-day pervades a good part of the whole domain of mathematics.

Galois died at the age of twenty-two (1832). Twice he presented memoirs to the Paris Academy, containing an account of his theory. The first was lost, the second was returned to its youthful author by Poisson as unintelligible. Galois' theory was first made public to the mathematical world in 1846 when Liouville published this latter memoir without comments. In 1858 Betti published an exposition of Galois' theory with complete proofs and some valuable extensions.

Lagrange in his great memoir of 1770–71 developed what he styled a *calcul des combinaisons* and which is in fact the origin of Galois' Theory of Equations. This new *calcul* was further developed in a number of papers by Ruffini, beginning 1799, who tried to demonstrate the impossibility of the algebraic solution of the general equation of degree greater than four by this means; by Gauss (1801) and Lagrange (1808) in the solution of the equations on which the roots of unity depend; and finally by Abel, who, besides being the first to rigorously demonstrate the insolvability of the quintic by radicals (1826), discovered a new class of algebraic solvable equations which occur in the division of the elliptic functions (1829).

The first work on Algebra to contain an account of Galois' theory was the second edition of Serret's ‘Algèbre’ (1866). Since then Galois' theory has been improved and greatly extended by many writers. In particular we mention Jordan. ‘Math. Annalen’ (vol. 1, 1869); ‘Traité des Substitutions’ (1870); Hölder, ‘Math. Annalen’ (vol. 34); Hilbert, Crelle's Journal (vol. 110); Kronecker, 'Festschrift' (1881; reprinted in Crelle, vol. 92). The best exposition of the theory to-day is to be found in H. Weber, 'Algebra' (2 vols., 2d edition, 1898–99). In English there is the translation of Netto's 'Substitutionentheorie' by F. N. Cole and Cajori, 'Theory of Equations' (1904). Brief accounts of the theory are Bolza, 'Theory of Substitution-Groups and its Application to Algebra,' Am. Jour. Math., vol. 13; Pierpont, 'Galois' Theory of Algebraic Equations,' Annals of Math. (1899–1900, vols. 1, 2).

BASAL NOTIONS.

Domain of Rationality.—One of the most fundamental notions in Galois' theory is that of a domain of rationality which was first clearly formulated by Abel. When an equation

$$f(x) = a_0x^n + a_1x^{n-1} + \ldots + a_{n-1}x + a_n = 0 \qquad (1)$$

offers itself for solution, its coefficients are supposed known. It often happens that other quantics are known, or are assumed as known. Suppose $\lambda, \mu, \ldots \omega$ are such quantics, finite in number. The totality of rational functions of these letters with rational numbers as coefficients constitutes a domain of rationality which we denote by

$$R(\lambda, \mu, \ldots \omega).$$

Thus any element of this domain may be obtained by a finite number of additions, subtractions, multiplications, and divisions performed on the letters $\lambda, \mu, \ldots \omega$. The domain of rationality which we lay at the base of a given algebraic investigation is to some degree a matter of choice. In any case, however, the coefficients of the equations we start with should lie in it.

Every domain must contain the domain $R(1)$, called the absolute domain, and which is simply the totality of rational numbers. For the domain $R(\lambda, \ldots \omega)$ must contain the element $\lambda/\lambda = 1$. It is often desirable to add certain elements $\eta, \zeta, \ldots$ to a domain $R(\lambda, \mu, \ldots)$, forming the new domain $R'(\lambda, \mu, \ldots \eta, \zeta, \ldots)$. The elements $\eta, \zeta, \ldots$ are said to be *adjoined* to R.

Rational Functions in R.—In elementary algebra and in the function theory a rational function of $x, y, z, \ldots$ is an expression of the form

$$\frac{Ax^{m_1}y^{m_2}z^{m_3}\ldots + \ldots}{Bx^{n_1}y^{n_2}z^{n_3}\ldots + \ldots}, \qquad (2)$$

where the exponents m, n are non-negative integers and the coefficients are merely independent of the variables $x, y, z, \ldots$ In Galois' theory the term rational function is a much narrower one. In fact the term rational has no meaning unless in connection with a specific domain of rationality. Thus the expression (2) is a rational function of $x, y, \ldots$ in Galois' theory with respect to the domain R, when and only when the coefficients $A, B, \ldots$ lie in R. Thus such a function as (2) may be rational with respect to one domain and not with respect to another. For example,

$$x + \sqrt{-3}y$$

is a rational function of x, y with respect to the domain $R(\rho)$, $\rho = e^{\frac{2\pi i}{3}}$; but it is not rational with respect to $R(1)$ or $R(\sqrt{-5})$. When the denominator in (2) reduces to a constant, it becomes a rational *integral* function.

An equation as (1) is *rational* with respect to R when its coefficients $a_0, a_1, \ldots a_n$ lie in R.

Reducibility and Irreducibility is another basal notion of Galois' theory. The rational integral function of $x, y, z \ldots$,

$$F(x, y, z, \ldots) = Ax^{m_1}y^{m_2}z^{m_3}\ldots + \ldots + Lx^{r_1}y^{r_2}z^{r_3}\ldots, \qquad (3)$$

with respect to the domain R is *reducible* in R when it is the product of two or more rational integral functions of $x, y \ldots$ with coefficients in R, viz., $F = G \cdot H \cdot I \ldots$ In this case we say F is divisible by $G, H, \ldots$, which are factors or divisors of F in the domain R. If the expression (3) cannot be split up into two such factors, it is *irreducible* with respect to R. An equation as (1) is reducible or irreducible in R according as its left side is reducible or irreducible in R.

An equation as (1) may be irreducible in one domain and reducible in another. Thus

$$x^2 + x + 1 = 0$$

is irreducible in $R(1)$, but is reducible in $R(\sqrt{-3})$. In fact,

$$x^2 + x + 1 = (x - \rho)(x - \rho^2), \quad \rho = e^{\frac{2\pi i}{3}}.$$

If $\xi_1, \ldots \xi_n$ are the roots of (1), it is obviously reducible in $R(\xi_1, \ldots \xi_n)$. In fact its left side splits up into rational linear factors,

$$f(x) = a_0(x - \xi_1) \ldots (x - \xi_n).$$

A theorem of utmost importance in Galois' theory is the following:

Let $f(x) = 0$, $g(x) = 0$ be rational equations for the domain R, and let $f(x) = 0$ be irreducible in R. If $g(x) = 0$ admits a root of $f(x) = 0$, it admits all the roots of $f(x) = 0$, and $g(x)$ is divisible by $f(x)$.

Equality.—As a third pillar on which Galois' theory rests is the distinction between *formal* and *numerical* equality, as we may designate it for lack of better terms. It is only by such a distinction that Galois was able to extend Lagrange's methods so as to apply to any type of algebraic equation. As long as we are dealing with constants, equality and inequality are of course the same as in arithmetic—they are numerical. What do we mean, however, by the equation

$$\phi(p, q, \ldots) = \psi(p, q, \ldots),$$

ϕ, ψ being rational functions of the variables $p, q, \ldots$ for a domain R? In general R will contain variable elements which then may enter the coefficients of ϕ, ψ. Let us write the above equation

$$\phi(v_1, v_2, \ldots c_1, c_2, \ldots) = \psi(v_1, v_2, \ldots c_1, c_2, \ldots),$$

where v_1, v_2 represent now all the variable elements in ϕ, ψ, among which will be $p, q, \ldots$, while $c_1, c_2, \ldots$ represent constants. By an equation of the above type we mean: *that for each and every set of numerical values $v_1, v_2, \ldots$ can take on consistent with their definition, the resulting numerical value of ϕ is identical with that of ψ.*

When no two of the quantities $\phi, \psi, \chi, \ldots$ are equal we shall call them *distinct* or *unequal.*

THE GALOISIAN RESOLVENT AND GROUP.

Construction of $n!$-valued Functions; Indeterminants.—Let

$$f(x) = a_0x^n + a_1x^{n-1} + \ldots + a_n = 0 \qquad (1)$$

be an equation whose solution is to be effected. The first thing to do is to choose a domain of rationality R. As already remarked, the nature of R depends partly upon (1) and partly upon our own pleasure. In any case it must contain the coefficients.

Without loss of generality we may suppose its roots unequal. For by means of the greatest common divisor of $f(x)$ and $f'(x)$ we may obtain by rational operations an equation whose roots are the distinct roots of (1).

Let us now adjoin n new variables $u_1, \dots u_n$ to R, forming a domain R', and introduce the rational function

$$V_1 = u_1x_1 + u_2x_2 + \dots + u_nx_n. \qquad (4)$$

If we permute the $x_1, x_2, \dots x_n$ in all possible ways, or, as we say, apply the $n!$ substitution

$$\begin{pmatrix} x_1 & x_2 & \dots & x_n \\ x_{\iota_1} & x_{\iota_2} & \dots & x_{\iota_n} \end{pmatrix}$$

of the symmetric group, we get the $n!$ functions

$$V_1, V_2, \dots V_{n!}. \qquad (5)$$

With these we form the equation

$$F(t; u_1, \dots u_n) = (t - V_1)(t - V_2) \dots (t - V_{n!}) = 0, \qquad (6)$$

whose coefficients lie in R'. In the discriminant of (6), $D(u_1, \dots u_n)$, we may give to $u_1, \dots u_n$ values, $\alpha_1, \dots \alpha_n$, in R, integral values, even, if we choose, in an infinity of ways so that $D \neq 0$. In that case the quantics (5) are distinct and the roots of (6) thus unequal. The function (4) has thus $n!$ values under the symmetric group. A special case of this function (4) was used by Lagrange; in its general form it was first employed by Abel. Its fundamental importance in the solution of algebraic equations was first brought out by Galois. For this reason the function V in (4) is called the *Galoisian resolvent function*. Besides the function (4) there are obviously an infinity of other $n!$-valued functions. The function (4) is employed on account of its simplicity.

On replacing the u's by the α's these variables disappear. Their introduction was to show the existence of $n!$-valued rational functions of the roots $x_1, \dots x_n$. Such auxiliary variables which we introduce into our reasoning, and which at any moment can be made to disappear by giving them appropriate special values, are called *indeterminates*. In a primitive way they are used by all mathematicians. Kronecker has shown that they are an implement of immense power in algebraic investigations. Since in the end we can always replace the indeterminates by values lying in our domain, we shall suppose that our domain contains in advance as many of these auxiliary variables as we care to use.

Galoisian Resolvent and Group.—In general the equation (6) is reducible in R, so that

$$F(t) = G(t, u_1, \dots u_n) G(t, u_1, \dots u_n) \dots$$

Let us take now any one of these irreducible factors, say that one which admits V_1 as root, to form the equation

$$G(t, u_1, \dots u_n) = 0. \qquad (7)$$

This is called the *Galoisian Resolvent of* (1) *for the domain R*. Let its degree in t be m.

Galois showed now that the solutions of (1) and (7) are equivalent problems. In fact every rational function of the roots of (1), and in particular the roots themselves and hence also the roots $V_2, V_3, \dots V_m$ of (7), are rational functions of V_1. We have therefore for any rational function of the x's

$$\phi(x_1, \dots x_n) = r_0 + r_1V_1 + r_2V_1^2 + \dots + r_{m-1}V_1^{m-1}.$$

The advance that is made by considering the equation (7) instead of the original equation (1) lies in the fact that the roots of (7) are rational in any one of them. Let the roots of (7) be

$$V_1, V_2, \dots V_m.$$

These are obtained from the expression (4) by effecting certain substitutions,

$$s_1 = 1, s_2, \dots s_m, \qquad (G)$$

on the roots $x_1, \dots x_m$. These m substitutions G enjoy now three remarkable properties:

1° *Every rational function $\phi(x_1, \dots x_m)$ of the roots of* (1) *which remains unaltered by G lies in R, or, as we say, is rationally known.*

2°. *If the rational function of the roots $\phi(x_1, \dots x_m)$ is rationally known, it remains unaltered for the substitutions G.*

3°. *The substitutions G form a group, and there is no other group of substitutions having the properties* 1°, 2°.

This group is called *the Galoisian group of the equation* (1) *for the domain R*. We say for the domain R, because by changing R the irreducible factors of (6) will in general change, and therefore the substitutions G will in general change. The importance of the Galoisian group, or, as we shall say more shortly, *the* Group, of an equation $f(x) = 0$ lies in the fact that an investigation of its structure reveals many of the most important properties the algebraic irrationalities defined by this equation. In particular it affords a rational and uniform scheme for effecting the solution of any algebraic equation. Before entering on this topic let us consider

SOME PROPERTIES OF THE GALOISIAN GROUP G.

Since the group G of an equation

$$a_0x^n + a_1x^{n-1} + \dots + a_n = 0 \qquad (1)$$

is unique for a given domain of rationality R, it follows: 1° that the group is independent of the particular $n!$-valued function we take; 2° that we get the same group whichever of the irreducible factors $G(t)$, $G_1(t)$, ... of (6) we may choose; and 3° that these functions G, G_1, ... are all of the same degree.

4°. *In any rational equation*

$$\phi(x_1, \dots x_n) = \psi(x_1, \dots x_n)$$

between the roots of (1) *the substitutions of G may be applied, and the result is a true equation.*

This is not true for all substitutions. For example, let

$$f(x) = x^3 - 1 = 0,$$

whose roots are

$$x_m = e^{\frac{2\pi i m}{3}}. \qquad m = 0, 1, 2.$$

Take as domain $R(1)$, and as rational relation

$$x_1x_2 = 1.$$

On applying the substitution

$$\begin{pmatrix} x_0 & x_1 & x_2 \\ x_1 & x_2 & x_0 \end{pmatrix} = (0, 1, 2)$$

this relation becomes,

$$x_0x_2 = 1,$$

which is false.

Group belonging to a Rational Function of the Roots and Rational Functions belonging to a Group.—Let

$$\phi(x_1, \ldots x_n)$$

be a rational function of the roots of (1). Since the group G of (1) contains the identical substitution, ϕ remains unaltered by at least one substitution of G and may remain unaltered by others. *These substitutions form a subgroup of G* called the group belonging to ϕ. On the other hand, let H be a subgroup of G. Any rational function $\phi(x_1, \ldots x_n)$ which remains unaltered by the substitutions of H but is changed by all other substitutions of G is said to belong to H. It is important to note that while the substitutions of the Galoisian group which leave a rational function $\phi(x_1, \ldots x_n)$ unaltered from a group, this property does not hold for substitutions which lie outside G. For example, the substitutions of the symmetric group S_6 which leave

$$\phi = x_1x_3, \quad x_m = e^{\frac{2\pi im}{6}}, \quad m = 0, 1, 2, 3, 4, 5,$$

do not form a group. This is due to the fact that the group of the equation

$$x^6 - 1 = 0,$$

the domain being $R(1)$, is not S_6 but a smaller group.

If $\phi(x_1, \ldots x_n)$, $\psi(x_1, \ldots x_n)$ belong to the same subgroup H of the Galoisian group, each can be expressed rationally in terms of the other.

RATIONAL RESOLVENTS.

Let $\phi(x_1, \ldots x_n)$ be a rational function of the roots of

$$a_0x^n + a_1x^{n-1} + \ldots + a_n = 0, \tag{1}$$

whose group for the domain R is G. Let ϕ belong to a subgroup H of G of index r. Then on applying the substitutions of G to ϕ it will take on r distinct values,

$$\phi, \phi_1, \ldots \phi_{r-1}, \tag{8}$$

which are called *conjugate functions.* They are in fact roots of an irreducible equation

$$\Phi(y) = (y - \phi)(y - \phi_1) \ldots (y - \phi_{r-1}), \tag{9}$$

whose coefficients lie in R. It is thus a rational equation. Suppose one of its roots, say ϕ, can be found. If we adjoin it to R, forming a domain R', the group of (1) is no longer G, but H.

Suppose not only ϕ but all the roots of (9) can be found. Their adjunction to R forms a domain R'' for which the group of (1) is the greatest invariant subgroup of G contained in H. In any case the adjunction of one or more roots of (9) produces a reduction of the group of the given equation (1). But in reducing the group of this equation we have made a step in its solution. For when the domain of rationality has been enlarged to such an extent that the group of the equation (1) embraces only the identical substitution, the roots of (1) are rationally known, that is, can be expressed rationally in terms of quantities lying in that domain of rationality. The equation (9) is called a resolvent equation, or more specifically a *rational resolvent*, since its roots ϕ, $\phi_1, \ldots$ are rational functions of the roots of the given equation (1).

The group of the resolvent equation (9) is of importance sometimes. In the functions (8) considered as functions of the x's, let us effect the substitutions of the group G. This gives rise to a substitution group Γ in the ϕ's, and this group is the group of the resolvent equation (9), the domain of rationality being that of G, viz., R. The groups G and Γ are isomorphic. To the identical substitution of Γ corresponds the group I above mentioned, viz., the subgroup of G, which leaves all the roots (8) unaltered. To any subgroup Γ_1 of Γ will correspond a subgroup G_1 of G, and conversely. In particular if Γ_1 is an invariant subgroup, G_1 is also invariant.

GALOIS' SOLUTION OF AN EQUATION.

Let G be the group of the equation

$$a_0x^n + a_1x^{n-1} + \ldots + a_n = 0 \tag{1}$$

for the domain R. Let H_1 be a subgroup of G of index r_1. Let $\phi_1(x_1, \ldots x_n)$ be any one of the infinity of rational functions belonging to H_1. Then ϕ_1 is root of a rational resolvent $\Phi_1(y) = 0$ of degree r_1. On solving $\Phi_1 = 0$ and adjoining one or more of its roots to form a new domain R_1, the group of (1) is now a subgroup of G_1 of G. Let H_2 be a subgroup of G_1 of index r_2, to which belongs the rational function $\phi_2(x_1, \ldots x_n)$. This is the root of a resolvent $\Phi_2(y) = 0$ of degree r_2. On solving $\Phi_2 = 0$ and adjoining one or more of its roots to form a new domain R_2, the group of (1) is now a subgroup G_2 of G_1. As the order of the groups G, G_1, $G_2, \ldots$ decreases, we must eventually arrive at the identical group when the roots of (1) are rationally known. Since the group G usually admits quite a variety of subgroups, and since the functions ϕ belonging to a given subgroup are infinite in number, Galois' theory shows that the number of ways for solving a given equation is endless. At the same time it clearly shows that the number of distinct ways is usually quite limited, depending on the subgroups of G.

Among the solutions of the equation (1) which Galois' theory offers, one class is particularly interesting, depending on a

Series of Composition.—This is defined as follows: Let G_1 be an invariant subgroup of G, such that G contains no invariant subgroup containing G_1. It is then a ***maximum invariant*** subgroup of G. If G has no maximum invariant subgroup besides the identical group, it is *simple.* The series of groups

$$G, G_1, G_2, \ldots G_\lambda = 1, \tag{10}$$

such that each is a maximum invariant subgroup of the preceding group, is called a *series of composition of G.* If the index of G_m under G_{m-1} is r_m, the numbers $r_1, r_2, \ldots r_\lambda$ are called *the factors of composition.* It may be possible to decompose a group G into a series of composition in more than one way. Thus the cyclic group C_6,

$$1, s, s^2, s^3, s^4, s^5,$$

where $s = \begin{pmatrix} x_1 x_2 x_3 x_4 x_5 x_6 \\ x_2 x_3 x_4 x_5 x_6 x_1 \end{pmatrix} = (1, 2, 3, 4, 5, 6)$ admits the series

$$C_6, A, 1$$

and

$$C_6, B, 1,$$

where

$$A = \{1, s^2, s^4\}, \quad B = \{1, s^3\}.$$

The factors of composition of the first series are 2, 3, while those of the second series are 3, 2. They are thus the same aside from their order. A theorem of *Jordan* states that *however a group be decomposed in a series of composition, the factors of composition are the same aside from their order.*

What makes the solution of an equation by means of a series of composition so remarkable is the fact that the resolvents $\Phi_1 = 0$, $\Phi_2 = 0, \ldots$, $\Phi_\lambda = 0$ corresponding to the subgroups G_1, $G_2 \ldots G_{\lambda-1}$ of (10) have groups $\Gamma_1, \Gamma_2, \ldots \Gamma_\lambda$ for their respective domains which are simple. Their orders are the factors of composition. Moreover, any root of one of these equations is a rational function of any root of that equation. Thus on adjoining one of its roots the same effect is produced as adjoining all. Finally, the resolvent equations $\Phi = 0$ are the simplest possible.

Cyclic Equation of Prime Degree.—When the group G of an equation $F(x) = 0$ is a cyclic group of prime order p its solution is readily effected, as Abel showed. Let the roots of $F = 0$ be $x_0, x_1, \ldots x_{p-1}$, and let $\gamma = (0, 1, \ldots p-1)$. Then

$$G = \{1, \gamma, \gamma^2, \ldots \gamma^{p-1}\}.$$

For the case in hand we may suppose the pth roots of unity $\rho, \rho^2, \ldots$ lie in the original domain of rationality. Consider the rational functions

$$\theta_h = x_0 + \rho^h x_1 + \ldots + \rho^{h(p-1)} x_{p-1}; \quad h = 1, 2, \ldots p-1.$$

On applying γ they go over into $\rho^{-h}\theta$. Hence $\theta_h^p = \theta_h$ are unaltered by γ and hence for G. They are therefore rationally known. On extracting a pth root we get

$$x_0 + \rho^h x_1 + \ldots + \rho^{h(p-1)} x_{p-1} = \sqrt[p]{\theta_h}.$$

This system of $p-1$ equations together with

$$x_0 + x_1 + \ldots + x_{p-1} = \sqrt{\theta_0}$$

gives

$$x_s = \frac{1}{p} \sum_{h=0}^{p-1} \rho^{-hs} \sqrt[p]{\theta_h}, \quad s = 0, 1, \ldots p-1.$$

The pth roots which enter here must be determined uniquely in terms of one of them, say $\sqrt[p]{\theta_1}$. The others are rational in this one, for

$$(x_0 + \rho^h x_1 + \ldots + \rho^{(p-1)h} x_{p-1}) \\ (x_0 + \rho x_1 + \ldots + p^{p-1} x_{p-1})^{p-h} = A_h$$

remains unchanged for γ and hence for G. Hence these A_h are rationally known. We have now

$$x_s = \frac{1}{p\theta_1} \sum_h \rho^{-hs} \left(\sqrt[p]{\theta_1}\right)^h A_h.$$

This result gives the theorem: *Cyclic equations of prime degree can be solved algebraically*, i.e., *by the extraction of roots from known quantities.*

Algebraic Solution of an Equation.—Let the equation

$$a_0 x^n + a_1 x^{n-1} + \ldots + a_n = 0 \qquad (1)$$

have a group G for a certain domain R, whose factors of composition

$$r_1, r_2, \ldots$$

are all primes. Then (1) can be solved algebraically. For the corresponding chain of resolvents

$$\Phi_1 = 0, \ \Phi_2 = 0, \ldots$$

have groups of prime orders $r_1, r_2, \ldots$; they are therefore cyclic equations, whose solution has just been effected. Since, as will be set forth later at more length, it is never necessary to employ other than rational resolvents, the above result leads to Galois' Criterion for the Solution of an Equation by Radicals. *In order that* (1) *admit an algebraic solution it is necessary and sufficient that the factors of composition of its Galoisian group consist of primes only.*

Application to the Solution of the Biquadratic

$$x^4 + a_1 x^3 + a_2 x^2 + a_3 x + a_4 = 0. \qquad (11)$$

For simplicity let us suppose its coefficients are independent variables. Let the original domain of rationality R embrace besides the coefficients a cube root of unity ρ. Then the group of (11) is the symmetric group S_4. As subgroups of S_4 we note the alternate group A_4, the axial group $G_4 = \{1, (12)(34), (13)(24), (14)(23)\}$, and the semiaxial group $G_2 = \{1, (12)(34)\}$. The groups $S_4, A_4, G_4, G_2, 1$ form a series of composition whose factors are obviously

$$2, 3, 2, 2.$$

As they are primes, the equation (11) admits an algebraic solution. To solve (11) let us proceed with Starkweather as follows: To form our first resolvent, let us use the subgroup A_4, and take as function belonging to this group

$$\phi = (x_1 - x_2)(x_1 - x_3)(x_1 - x_4) \\ (x_2 - x_3)(x_2 - x_4)(x_3 - x_4) \qquad (12)$$

The corresponding resolvent is

$$\Phi = \phi^2 - \Delta = 0, \qquad (13)$$

where Δ is the discriminant of (11).

On adjoining $\phi = \sqrt{\Delta}$ our domain is $R_1(R, \sqrt{\Delta})$, for which the group of (11) is A_4.

A subgroup of A_4 is G_4. A rational function belonging to this is

$$\psi = x_1 x_2 + x_3 x_4.$$

This gives the resolvent

$$\Psi = \psi^3 - a_2 \psi^2 + (a_1 a_3 - 4a_4)\psi \\ - \{a_4(a_1^2 - 4a_2) + a_3^2\} = 0. \qquad (14)$$

The solution of this cubic, which is a cyclic equation, gives ψ as a known explicit function of quantics in R_1. On adjoining ψ we get the domain $R_2(R, \sqrt{\Delta}, \psi)$, for which the group of (11) is G_4. The next subgroup we take is G_2 to which belongs

$$\chi = x_1 + x_2 - (x_3 + x_4).$$

This gives the resolvent

$$X = \chi^2 - (4\psi + a_1^2 - 4a_2) = 0.$$

The extraction of a square root gives χ, whose adjunction produces the domain $R_3(R, \sqrt{\Delta}, \psi, \chi)$, for which the corresponding group of (11) is G_2. The last group we take is the identical group, to which belongs x_1. The corresponding resolvent is

$$x^2+\tfrac{1}{2}(a_1-\chi)x+\tfrac{1}{2}\left(\psi+\frac{2a_3-a_1\psi}{\chi}\right)=0.$$

The solution of this quadratic gives x_1. Its adjunction gives the domain $R_4(R, \sqrt{\Delta}, \psi, \chi, x_1)$, for which the group consists only of the identical substitution. Hence all the other roots of (11), viz., x_2, x_3, x_4, must lie in R_4. This is indeed so, for

$$x_2=x_1-\tfrac{1}{2}a_1+\tfrac{1}{2}\chi.$$

To get x_3, x_4, we note that if ψ', ψ'' denote the two other roots of (14),

$$\alpha=\psi'-\psi''=\frac{(\psi-\psi')(\psi-\psi'')(\psi'-\psi'')}{(\psi-\psi')(\psi-\psi'')}.$$

Here the numerator is the square root of the discriminant of (14), which, as is well known, is the same as the discriminant Δ of (11). The denominator is obviously $\frac{d\Psi}{d\psi}$. Thus

$$\alpha=\frac{\sqrt{\Delta}}{\Psi'}=(x_1-x_2)(x_3-x_4),$$

a quantity lying in R_4.

Moreover, x_1, x_2 being already found, $x_1-x_2=\beta$ and $x_1+x_2=\gamma$ are known; also $x_1+x_2+x_3+x_4=\gamma+x_3+x_4=-a_1$ is known. This last with $\beta(x_3-x_4)=\alpha$ gives x_3 and x_4.

Lagrange's Solution instead of employing a series of composition uses the following subgroups, A_4, O, G_2, 1, where

$$O=\{1, (1324), (13)(24), (1423), (12), (34), (12)(34), (14)(23)\}.$$

As rational function belonging to A_4 Lagrange uses the function (12), which gives rise to the resolvent (13). As rational function belonging to O, Lagrange takes

$$\theta=\{x_1+x_2-(x_3+x_4)\}^2,$$

whose conjugate values are

$$\theta_1=\{x_1+x_3-(x_2+x_4)\}^2,\quad \theta_2=\{x_1+x_4-(x_2+x_3)\}^2.$$

The corresponding resolvent is

$$\Theta=\theta^3-(3a_1^2-8a_2)\theta^2+(3a_1^4-16a_1^2a_2+16a_2^2$$
$$+16a_1a_3-64a_4)\theta-(a_1^3-4a_1a_2+8a_3)^2=0.$$

For the subgroup G_2 he takes

$$\eta=x_1+x_2-(x_3+x_4),$$

which gives the resolvent

$$H=\eta^2-\theta=0.$$

For the identical group 1, Lagrange uses

$$\omega=x_1+x_3-(x_2+x_4),$$

which gives the resolvent

$$\Omega=\omega^2-\theta_1=0.$$

For the domain $R'(R, \sqrt{\Delta}, \theta_1, \theta_2, \theta_3, \eta, \omega)$, the group of the biquadratic is (1), and its roots therefore lie in R'. In fact we have

$$x_1+x_2-x_3-x_4=\sqrt{\theta},$$
$$x_1+x_3-x_2-x_4=\sqrt{\theta_1},$$
$$x_1+x_4-x_3-x_2=\sqrt{\theta_2},$$
$$x_1+x_2+x_3+x_4=-a_1.$$

From which we get

$$x_s=\tfrac{1}{4}(-a_1+\sqrt{\theta}+\sqrt{\theta_1}+\sqrt{\theta_2}),\ s=1, 2, 3, 4.$$

Here we choose at will the signs of $\sqrt{\theta}$, $\sqrt{\theta_1}$. The sign of $\sqrt{\theta_2}$ is then determined, for

$$\sqrt{\theta}\sqrt{\theta_1}\sqrt{\theta_2}=4a_1a_2-a_1^3-8a_3.$$

Abelian Equations.—Let G be the group of an equation $f(x)=0$ for a certain domain. If the substitutions of G are commutative, that is, if $s_\iota s_\kappa=s_\kappa s_\iota$ for any two substitutions s_ι, s_κ of G, the equation $f=0$ is called Abelian in honor of Abel, who first studied them. We may show at once that every subgroup of G is invariant and that its factors of composition are all primes. Hence *all Abelian equations can be solved algebraically*. The most important equations of this type are the equations of degree $\phi(n)$ on which the nth roots of unity depend. Here $\phi(n)$, called the *totient* of n, is

$$n\left(1-\frac{1}{p}\right)\left(1-\frac{1}{q}\right)\dots,$$

where $p, q, \dots$ are the different prime factors of n. The domain of rationality is $R(1)$.

Equation of Degree >4.—The group of the equation (1) when no restrictions are placed on the coefficients, *i.e.*, when they are independent variables, and when the domain of rationality contains not only the coefficients but any constants, is the symmetric group. When $n=2$, 3, 4, its factors of composition are primes. Not so when $n>4$. In this case its only invariant subgroup besides the identical group is the alternate group whose order is $\tfrac{1}{2}n!$. Thus the factors of composition are 2, $\tfrac{1}{2}n!$. The latter is not a prime. We have thus *Abel's Theorem: Equations of degree* >4, *whose group is the symmetric group, cannot be solved algebraically; i.e.*, their roots cannot be found by extracting roots from known quantities.

We have just observed that when the coefficients of an equation of degree >4 are independent variables, it cannot be solved algebraically. From that we cannot, however, deny that *every* equation of degree >4 with constant coefficients *may* admit an algebraic solution. This important question was finally settled by Hilbert, who showed that there are an infinity of equations of any degree with rational integral coefficients whose group in $R(1)$ is the symmetric group.

IRRATIONAL RESOLVENTS.

Up to the present we have considered the effect on the Galoisian Group of an equation, of adjoining roots of rational resolvents to the current domain of rationality. In many investigations it is important to consider the adjunction of roots of equations which may not be rational functions of the roots of the given equation. Equations whose roots are not rational functions of the roots of the given equation are called *irrational resolvents* when used in the solution of the given equation. A theorem which lies at the foundation of this subject is due to Kronecker. *Let* $f(x)=0$, $g(y)=0$ *be two rational irreducible equations for the domain* R *of degrees* m, n *respectively. If on adjoining a root* x_1, *of* $f=0$, $g(y)$ *becomes reducible, the adjunction of a root* y_1, *of* $g=0$, *will make* $f(x)$ *reducible. If* $\phi(x)$, $\psi(x)$ *of degrees* α, β, *respectively, be the* *irreducible factors for the new domains that x_1, y_1 satisfy, then*

$$\frac{m}{\alpha} = \frac{n}{\beta}.$$

As an important corollary of Kronecker's theorem we have: Let the adjunction of y_1 reduce the group G of $f(x)=0$ to an invariant subgroup of index i. Then n is a multiple of i and hence never less than i. When $n=i$ (and this is always the case if n is a prime) $g(y)=0$ is a rational resolvent.

Another theorem of great importance in this connection is due to Jordan. *If the adjunction of all the roots of $g(y)=0$ reduces G to a subgroup G_1 of index i, the adjunction of all the roots of $f(x)$ reduces the group H of $g(y)$ to a subgroup H of index k. The two groups G_1, H_1 are invariant and $i=k$. Finally, when H is simple $g(y)=0$ is a rational resolvent.*

Application to Some Celebrated Problems.—The Delian Problem or duplication of the cube requires the solution of

$$x^3 - 2 = 0$$

by rule and compass. The construction of the regular polygons by rule and compass is another famous problem of antiquity. Its solution depends upon the irreducible equation of degree $\phi(n)$ already referred to. That the Delian Problem is impossible follows at once from the theorem: *In order that a root, real or imaginary, of an irreducible equation $f(x)=0$ can be constructed geometrically it is necessary that the degree of f be a power of two.* From this theorem we also conclude: *The necessary and sufficient condition that a regular polygon of n sides can be constructed by rule and compass is that the totient of n is a power of two.*

Another famous question is the *Casus Irreducibilis* of cubic equations. The theory of irrational resolvents enables us to prove readily the following general theorem: *An irreducible equation of degree n whose roots are all real can never be solved by real radicals alone if n contains other factors than two.*

That the casus irreducibilis is indeed such follows as corollary of this theorem.

Hölder's Theorem.—One of the most important and fundamental contributions to Galois' theory in recent years is a theorem of Hölder. Speaking roughly, it asserts that however the solution of a given equation $f(x)=0$ be conducted, sometime in the course of the solution certain simple equations whose groups are uniquely determined and known in advance must be employed. When the group of $f(x)=0$ is simple (in which case we say $f(x)$ is simple) it can be solved by no other simple equation $g(y)=0$ essentially different from $f=0$. The solution of any given equation therefore depends upon a chain of simple equations. But of all simple equations belonging to a given group certain ones will enjoy peculiar properties which will recommend their selection as *normal* equations. The reduction of the given equation to these normal equations is a problem by itself.

THE SOLUTION OF THE QUINTIC.

We have seen that the equation of fifth degree $Q=0$ whose group is the symmetric group cannot be solved by means of radicals, *i.e.*, by resolvents of the type $x^m - a = 0$. On adjoining the square root of its discriminant $\sqrt{\Delta}$, the group of $Q=0$ reduces to the alternate group A_5 of 60 substitutions. But A_5 is simple. Thus $Q=0$ is a simple equation for the domain $R(\sqrt{\Delta})$. Other algebraic equations having this group arise in the theory of linear differential equations, and also in the theory of elliptic functions. In fact the hypergeometric function

$$F(\alpha, \beta, \gamma, x) = 1 + \frac{\alpha\cdot\beta}{1\cdot\gamma}x + \frac{\alpha\cdot\alpha+1\cdot\beta\cdot\beta+1}{1\cdot2\cdot\gamma\cdot\gamma+1}x^2 + \dots$$

is a solution of a very simple differential equation of the second order $G=0$. For variable α, β, γ it represents a new transcendent; but for certain values of these parameters it reduces to the elementary functions; *e.g.*, it may become algebraic. In seeking for these latter cases Schwarz was led to introduce a new variable s, the quotient of two fundamental integrals of $G=0$. This variable for certain values of α, β, γ satisfies the equation

$$J(s) = 1728x\, f^5(s) + H^3(s) = 0,$$

where

$$f(s) = s(s^{10} + 11s^5 - 1),$$
$$H(s) = s^{20} - 288s^{15} + 494s^{10} + 288s^5 + 1.$$

The equation $J=0$ stands in so intimate relation with the icosahedron that it is called the icosahedral equation. Indeed if we project stereographically the icosahedron on the s-plane, the centre being at the origin, the 12 vertices and the middle points of the 20 faces will be precisely the roots of f and H, respectively.

From this it is easy to conclude that the group of $J=0$ is formed of the 60 rotations which leave the icosahedron unchanged. Klein has shown that the icosahedral equation whose roots are very simple known functions of $F(\alpha, \beta, \gamma, x)$ can be put in connection with $Q=0$. The equation $J=0$ may thus be considered as a normal resolvent of the quintic.

A normal resolvent which springs from the elliptic functions is the following: In trigonometry one of the problems is to express $\sin\frac{x}{n}$ in terms of $\sin x$, n a prime number. This may be done algebraically, as is readily shown. In the elliptic functions the same problem arises. Here the algebraic relation between $\mathrm{p}\left(\frac{u}{n}, \omega_1\, \omega_2\right)$ and $\mathrm{p}(u, \omega_1\, \omega_2)$ is of degree n^2-1. The solution of this equation depends upon an equation of degree $n+1$ called an equation of transformation. For $n=5$ such an equation is

$$\Delta^2 y^6 + 10\Delta y^3 - 12g_2 y + 5 = 0, \qquad (15)$$

whose group is the above A_5 and whose roots are

$$\left(\mathrm{p}\frac{2\omega_1}{5} - \mathrm{p}\frac{4\omega_1}{5}\right)^{-1}$$

and

$$\left(\mathrm{p}\frac{2\omega_2 + 48r\omega_1}{5} - \mathrm{p}\frac{4\omega_2 + 96r\omega_1}{5}\right)^{-1},$$

$$r = 0, 1, 2, 3, 4.$$

Here Δ is the discriminant $g_2^3 - 27g_3^2$. How equations of this type could be set in relation with the quintic was first shown by Hermite in 1858. The equation (15) was used by Kiepert. It forms a very convenient normal resolvent of the quintic.

Having found in the elliptic functions convenient normal resolvents for the quintic, we might hope to employ the equations of transformation of higher orders to solve the general equations of higher degrees. The consideration of their groups, however, shows very easily that this is not possible. To find suitable equations we must pass from the elliptic to the hyperelliptic functions. By their aid the general equation of every degree can be solved.

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Equations, General Theory of. The theory of equations finds its origin in efforts to solve the equations which arise in the applications of algebra to problems in pure geometry or in applied mathematics. In the exposition of this theory a rational integral algebraic function of x arises which may be defined as follows:

$$f(x) = a_0x^n + a_1x^{n-1} + a_2x^{n-2} + \ldots + a_{n-1}x + a_n.$$

It is assumed here that the exponent n is a positive integer and that the coefficients a_0, a_1, $a_2, \ldots, a_n$ are algebraic numbers independent of x. If this polynomial is put equal to zero, we have an equation of the nth degree. Any value of the variable x which makes the value of the polynomial zero is said to «satisfy the equation» $f(x) = 0$ and is called a «root» of the equation. Thus, -1 is a root of the equation $x^2 + x + 2 = 0$, because $(-1)^2 + (-1) + 2 = 0$.

Fundamental Theorems about Roots.—That at least one root of the equation $f(x) = 0$ always exists is a fundamental theorem which it is somewhat difficult to establish rigorously. The proofs usually given in elementary texts lack rigor. Among the most satisfactory demonstrations are the four given by C. F. Gauss and the one based on the theory of functions, given by A. L. Cauchy. Granted that every equation of the nth degree has at least one root, it is easy to show that it has n roots and no more. An equation of the second dergee (a «quadratic equation») has two roots, one of the third degree (a «cubic equation») has three roots, one of the fourth degree (a «quartic» or «biquadratic equation») has four roots, and so on. The proof of this theorem may be outlined as follows: If r_1 is a root of $f(x) = 0$, then $f(x)$ is divisible by $x - r_1$ without a remainder, so that $f(x) = (x - r_1)f_1(x)$, where $f_1(x)$, the quotient, is of the $(n-1)$th degree. If r_2 is a root of $f_1(x) = 0$, then in the same way $f_1(x) = (x - r_2)f_{\prime\prime}(x)$, and $f(x) = (x - r_1)(x - r_2)f_{\prime\prime}(x)$. Proceeding in this manner, the degrees of the successive quotients diminish by unity at every step, until finally a binomial quotient of the first degree of the form $a_0(x - r_n)$ is obtained. We then have $f(x) = a_0(x - r_1)(x - r_2) \ldots (x - r_n) = 0$. There are here n binomial factors and no more, each of which, when equated to zero, yields a root. In special cases some of these roots may be equal to each other. Such roots are called «equal» or «multiple» roots.

There are important relations existing between the roots and the coefficients of an equation. From the equalities

$$(x - r_1)(x - r_2) = x^2 - (r_1 + r_2)x + r_1r_2 = 0;$$

$$\begin{aligned}(x - r_1)(x - r_2)(x - r_3) = x^3 &- (r_1 + r_2 + r_3)x^2 \\ &+ (r_1r_2 + r_1r_3 + r_2r_3)x - r_1r_2r_3 = 0;\end{aligned}$$

$$\cdots\cdots\cdots\cdots\cdots\cdots$$

$$\begin{aligned}(x - r_1)(x - r_2) \ldots (x - r_n) = x^n& \\ - (r_1 + r_2 + \ldots + r_n)x^{n-1}& \\ + (r_1r_2 + r_1r_3 + \ldots + r_{n-1}r_n)x^{n-2}& \\ - \ldots + (-1)^n r_1r_2 \ldots r_n = 0&\end{aligned}$$

we see that in the equation $f(x) = 0$, when $a_0 = 1$, the coefficient a_1 of the second term is equal to minus the sum of the roots; the coefficient a_2 of the third term is equal to the sum of the products of the roots, taken two by two; the coefficient a_3 of the fourth term is equal to minus the sum of the products of the roots, taken three by three; and so on, until finally we arrive at the last coefficient, a_n, which is equal to $(-1)^n$ times the product of all the roots. The coefficients of the equation are said to be *symmetric functions* of the roots, that is, functions in which any two roots may be interchanged without altering the value of the function. As an illustration take $2x^3 + 4x^2 + 6x - 5 = 0$. To make $a_0 = 1$, divide through by 2. Then the sum of the three roots is -2, the sum of their products, taken two by two, is 3, the product of all three roots is $\frac{5}{2}$.

The roots of an equation may be complex (*i.e.*, imaginary) quantities. (See ALGEBRA.) Thus the equation $x^2 + x + 1 = 0$ has the two complex roots $\frac{1}{2}(-1 + i\sqrt{3})$ and $\frac{1}{2}(-1 - i\sqrt{3})$, where $i = \sqrt{-1}$. If the coefficients of the equation $f(x) = 0$ are all real, then it can be shown that, if complex roots occur at all, they occur in conjugate pairs; that is, if $a + ib$ is a root, then $a - ib$ is likewise a root. From this it follows at once that no cubic or other equation of odd degree and with real coefficients can have all its roots complex. Considerable information on the character of the roots can usually be secured from «Descartes' Rule of Signs,» which may be stated as follows: *An equation with real coefficients has as many positive roots as it has variations in sign, or fewer by an even number.* A variation is said to exist whenever two successive terms have opposite signs. Thus there are two variations in $+ - - +$. The theorem may be proved from the consideration that every time that a new positive root is introduced into an equation, by multiplying $f(x)$ by $(x - r)$, the number of variations is increased by an odd number. Applying Descartes' Theorem to the equation $x^6 - x^5 + x^4 + 2x^2 - 5 = 0$, observe that the sequence of signs is $+ - + + -$. There are three variations; hence, the equation has either three or one positive root. To apply the theorem to negative roots, we first transform the given equation into a new one whose roots are the same as those of the given equation, excepting in sign. This can be done by writing $-x$ in place of x. The above sextic then becomes $x^6 + x^5 + x^4 + 2x^2 - 5 = 0$. This transformed equation has one variation; hence, by Descartes' Rule (*q.v.*), it has one positive root, and the given equation has one negative root. As the total number of roots is six and the number of real roots is four or two, it follows that either two or four of the roots are complex. By the same reasoning we can show that $x^5 - 1 = 0$ has one positive and four complex roots and that $x^4 + x^2 + 1 = 0$ has all its roots complex. In some cases, as in $x^4 + x^3 - x^2 + 5 = 0$, Descartes' Rule gives but little information.

Strenuous efforts have been put forth by mathematicians to discover theorems by which the exact number of real and of complex roots of equations with real coefficients can always be determined. The most noted result of these efforts is the theorem of J. C. F. Sturm, discovered in 1829. Sturm's theorem tells the number of complex roots, and the number of real roots within a given interval, with unfailing certainty; but it labors under the disadvantage of being laborious in its application. Hence it is commonly used only when the simpler methods fail to give the wanted information. We state the theorem for the special case when $f(x)=0$ has no equal roots. Let $f'(x)$ be the first derived function of $f(x)$. (See CALCULUS.) Then proceed with the process of finding, by division, the highest common factor of $f(x)$ and $f'(x)$, with this modification, that the sign of each remainder be changed before it is used as a divisor. Continue the process until a remainder is reached which does not contain x, and change the sign of that also. The functions $f(x)$, $f'(x)$, together with the several remainders with their signs changed, viz., $f_2(x)$, $f_3(x)$, . . . , $f_n(x)$, are called «Sturm's functions.» Sturm's theorem is as follows: *If $f(x)=0$ has no equal roots, let any two real quantities a and b be substituted for x in Sturm's functions, then the difference between the number of variations of sign in the series when a is substituted for x and the number when b is substituted for x expresses the number of real roots of $f(x)=0$ between a and b.* To make this clearer, take $f(x)=x^3-x^2-10x+1$, then $f'(x)=3x^2-2x-10$, $f_2(x)=62x+1$, $f_3(x)=38,313$. For the indicated values of x the signs of the Sturmian functions are as follows:

x	$f(x)$	$f'(x)$	$f_2(x)$	$f_3(x)$
∞	+	+	+	+
4	+	+	+	+
3	−	+	+	+
1	−	−	+	+
0	+	−	+	+
−2	+	+	−	+
−3	−	+	−	+
$-\infty$	−	+	−	+

Since $x=\infty$ gives no variations and $x=-\infty$ gives three variations, there are three real roots between ∞ and $-\infty$. Hence there are no complex roots. The real roots lie between 3 and 4, 0 and 1, −2, and −3.

Transformations of Equations.—The study of the properties of an equation is frequently facilitated by the transformation of the given equation into a new one whose roots (coefficients) bear a given relation to the roots (coefficients) of the original equation. Thus, in applying Descartes' Rule to negative roots we transformed the equation into another whose roots were numerically the same, but differed in sign. If the roots of the new equation are to be m times those of the one given, we place $y=mx$ and substitute y/m for x. For instance, if the roots of the transformed equation are to be ten times those in $x^3-x^2-2x+5=0$, we get $\frac{y^3}{1000}-\frac{y^2}{100}-\frac{2y}{10}+5=0$, or $y^3-10y^2-200y+5000=0$. The result is obtained more easily by the rule: *Multiply the second term by m, the third by m^2; and so on.* If the roots of the new equation are to be the reciprocals of the roots of the old we write $x=\frac{1}{y}$. A more important transformation is the one of diminishing the roots by a given number h. We have here $y=x-h$. Substituting $y+h$ for x in $a_0x^n+a_1x^{n-1}+a_2x^{n-2}+\ldots+a_n=0$, we obtain

$$a_0(y+h)^n+a_1(y+h)^{n-1}$$
$$+a_2(y+h)^{n-2}+\ldots+a_n=0.$$

Expanding the binomials and collecting like terms, we obtain, let us suppose,

$$A_0y^n+A_1y^{n-1}+A_2y^{n-2}+\ldots+A_n=0.$$

Writing $x-h$ for y we get

$$A_0(x-h)^n+A_1(x-h)^{n-1}$$
$$+\ldots+A_{n-1}(x-h)+A_n=0,$$

which differs from the original equation merely in form. This new form suggests an easy way for carrying out the actual computation. Dividing the left member by $x-h$, the remainder obtained is seen to be A_n, the absolute term. Dividing the quotient thus obtained by $x-h$, the remainder is A_{n-1}. By repeating this process the remaining coefficients of the required equation are secured. The process, called «synthetic division,» is very convenient in this transformation. Suppose we desire to transform $x^4+8x^3-x+6=0$ into another in which the second term is wanting. The sum of the roots is −8; hence, to cause x^3 to disappear, we must increase each root by 2 (*i.e.*, diminish by −2). Dividing successively by $x+2$ we obtain the coefficients −40, 63, −24, 0, 1, and the required equation is $x^4-24x^2+63x-40=0$.

The transformations thus far considered are all special cases of the so-called *homographic* transformation, in which $y=\frac{ax+b}{cx+d}$, a, b, c, d being constants. Thus, if $a=d=1$ and $c=0$, we have the preceding transformation. The homographic transformation is of interest in geometery, in the study of homographic ranges of points. The most general rational algebraic transformation of the roots of an equation $f(x)=0$ of the nth degree can always be reduced to an integral transformation of a degree not higher than the $(n-1)$th, and can, therefore, be represented by the relation

$$y=d_1+d_2x+d_3x^2+\ldots+d_nx^{n-1}.$$

This last is known as the «Tschirnhausen transformation,» by which Tschirnhausen in 1683 hoped to be able to reduce the general equation of the nth degree to the binomial form $x^n-a=0$, which is always solvable. But this transformation to the binomial form can be effected only for general equations that are lower than the fifth degree.

Solution of Equations.—This subject resolves itself into two quite distinct parts: (1) The solution of numerical equations (*i.e.*, equations whose coefficients are given numbers) by some method of approximation to the exact value of the roots; (2) the solution of equations, whose coefficients are either given numbers or letters, by operations which will give the accurate values of the roots, expressed in terms of the coefficients,—such expressions to involve no other processes than addition, subtraction, multiplication, division, and the extraction of roots. The former is called a solution *by approximation*, the second is called the *algebraic* solution of equations. In the former each root may be found separately, in the latter a general expression is obtained which represents all of the roots indifferently. The former is of importance to the practical computor, the latter is of special interest to the pure mathematician. The solution by approximation can be effected for equations of any degree; the algebraic solution is impossible for general equations of the fifth or of higher degrees. (See EQUATIONS, GALOIS' THEORY OF.)

Algebraic Solution of Equations.—The algebraic solution of the quadratic equation $ax^2+bx+c=0$ is well known. (See ALGEBRA.) The algebraic solution of the cubic, due to Scipio Ferro and Tartaglia, and first published by H. Cardan in 1545, is known as 'Cardan's solution.' To effect it, first transform the general cubic equation so that the second term shall be wanting. This done, we have $x^3+ax+b=0$. Putting $x=y+z$ we obtain

$$y^3+3yz(y+z)+z^3+a(y+z)+b=0,$$

or
$$y^3+z^3+(3yz+a)(y+z)+b=0.$$

We may subject y and z to any second condition which is not inconsistent with $x=y+z$. It will be convenient to assume $3yz+a=0$. Then $y^3+z^3+b=0$, or, substituting for z its value $-a/3y$, we obtain $y^6+by^3=\frac{a^3}{27}$ and

$$y^3=-\frac{b}{2}\pm\sqrt{\frac{b^2}{4}+\frac{a^3}{27}},$$

$$z^3=-y^3-b=-\frac{b}{2}\mp\sqrt{\frac{b^2}{4}+\frac{a^3}{27}}.$$

Since $x=y+z$, we have

$$x=\sqrt[3]{-\frac{b}{2}+\sqrt{\frac{b^2}{4}+\frac{a^3}{27}}}+\sqrt[3]{-\frac{b}{2}-\sqrt{\frac{b^2}{4}+\frac{a^3}{27}}}.$$

Since y^3 and z^3 have each three cube roots, it might seem as if $y+z$ or x had altogether nine values. As the cubic has only three roots, this cannot be. Of the nine values, six are excluded by the relation $3yz+a=0$, which y and z must satisfy. Eliminating z between $x=y+z$ and $3yz+a=0$, we get $x=y-\frac{a}{3y}$, where y has the three values obtained from the expression for y^3 given above. This last expression for x does not involve the difficulties of the first expression. If the numerical values of the coefficients a and b are given, the numerical values of the roots may be obtained by substituting the values of a and b in the above expression for x. In any case, this mode of computing x is more laborious than Horner's method of approximation (explained below), but when all three roots of the cubic are real and distinct, an unexpected difficulty is encountered. In this case $\frac{b^2}{4}+\frac{a^3}{27}$ represents a negative number. As the square root of a negative number is a complex (imaginary) number, we are required to find the cube root of a complex number. But there exists no convenient arithmetical process for doing this. Nor is there any way of avoiding the complex radicals and of expressing the values of the real roots by real radicals. This is the famous 'irreducible case' in the solution of the cubic. Its interest is purely theoretical. The practical computor experiences no difficulty, for he can always find the values of x by the methods of approximation.

Since Cardan's time a great many different algebraic solutions of the cubic and also of the quartic have been given. They are brought together for convenient reference in L. Matthiessen's 'Grundzüge der Antiken und Modernen Algebra,' Leipzig, 1878. We proceed to give Euler's algebraic solution of the general quartic. By transforming it, bring it to the form $x^4+ax^2+bx+c=0$. Assume the general expression for a root to be $x=\sqrt{u}+\sqrt{v}+\sqrt{w}$. Squaring,

$$x^2-u-v-w=2\sqrt{u}\sqrt{v}+2\sqrt{u}\sqrt{w}+2\sqrt{v}\sqrt{w}.$$

Squaring again and simplifying,

$$x^4-2x^2(u+v+w)-8x\sqrt{u}\sqrt{v}\sqrt{w}$$
$$+(u+v+w)^2-4(uv+uw+vw)=0.$$

Equating coefficients of this and the given quartic we have

$$a=-2(u+v+w),\quad b=-8\sqrt{u}\sqrt{v}\sqrt{w},$$
$$c=(u+v+w)^2-4(uv+uw+vw).$$

But $-(u+v+w)$, $(uv+uw+vw)$, $-uvw$ are the coefficients of a cubic whose roots are u, v, w. This cubic, called 'Euler's cubic,' is

$$y^3+\frac{a}{2}y^2+\frac{a^2-4c}{16}y-\frac{b^2}{64}=0.$$

Solving it, we have the values of u, v, and w, and, therefore, the values of x. Of the eight apparent values of x, four are excluded by the relation $b=-8\sqrt{u}\sqrt{v}\sqrt{w}$. To solve the quartic by the present method we must, therefore, first solve 'Euler's cubic,' called the *resolvent*. When this resolvent has a rational root, then its other two roots can be expressed in terms of square roots and the quartic can be solved algebraically without the extraction of cube roots. All methods of solving algebraically the general quartic depend upon the solution of some resolvent cubic.

Binomial equations of the form $x^n-1=0$, or more generally, of the form $x^n-a=0$, can always be solved algebraically. They possess also many interesting properties. We shall give a *trigonometric* solution and mention a few of these properties. Let $x^n=a=r[\cos(2k\pi+\theta)+i\sin(2k\pi+\theta)]$, where a may be a complex quantity, where k may be any integer, and where r and θ are known from the value of a. (See TRIGONOMETRY.) By De Moivre's theorem we obtain

$$x=\sqrt[n]{r}\left\{\cos\frac{2k\pi+\theta}{n}+i\sin\frac{2k\pi+\theta}{n}\right\}.$$

By assigning to k any n consecutive integral values we obtain n distinct values for x and no more than n, since the n values recur in periods. These values are the roots required.

Among the properties of $x^n-1=0$ are the following: It has no multiple roots; if r is a root, then any positive integral power of r is a root; if m and n are relatively prime, then $x^m-1=0$ and $x^n-1=0$ have no roots in common, except 1; if h is the highest common factor of m and n, then the roots of $x^h-1=0$ are common to $x^m-1=0$ and $x^n-1=0$; if r is a complex root of $x^n-1=0$, n being a prime number, then $1, r, r^2, \ldots, r^{n-1}$ are the roots; the roots of $x^m-1=0$ and $x^n-1=0$ satisfy the equation $x^{mn}-1=0$; $x^n-1=0$ has always *primitive* roots, *i.e.*, roots which are not also roots of unity of a lower degree than n. For the proofs consult Burnside and Panton, 'Theory of Equations,' vol. I. The theory of roots of unity is closely allied with the problem of inscribing regular polygons in a circle, or the theory of the 'division of the circle.' Consult P. Bachmann, 'Kreistheilung,' Leipzig, 1872.

Solution by Approximation.—Of the various methods which have been given for the solution of numerical equations, the most satisfactory, all things considered, is the one known as «Horner's method.» It is commonly used for finding *incommensurable* roots (*i.e.*, such as involve an interminable decimal which is not a repeating decimal), but it may be used also for finding *commensurable* roots (*i.e.*, such as are integers or rational fractions). It is desirable here to begin with the theorem that *a rational fraction cannot be a root of an equation of the nth degree with integral coefficients, the coefficient of x^n being unity.* To prove this, let, if possible, $\frac{h}{k}$ be a root of $f(x)=0$, where h and k are integers and $\frac{h}{k}$ a fraction reduced to its lowest terms, and where $a_0=1$. Substitute $\frac{h}{k}$ for x, then multiply both members of the equation by k^{n-1}, and we obtain, after transposing, $\frac{h^n}{k}=-a_1h^{n-1}-a_2h^{n-2}k-\ldots-a_nk^{n-1}$. This equation is impossible, since a fraction in its lowest terms cannot equal an integer. Hence $\frac{h}{k}$ cannot be a root. This being the case, it follows that all commensurable roots are exact divisors of a_n, for a_n is numerically the product of all the roots. We know that if (fx) is divisible by $x-r$, without a remainder, r is a root. Hence we are enabled to find all commensurable roots of numerical equations of the type now under consideration by testing in succession each factor of a_n. For instance, in the equation $x^3+8x^2+13x+2=0$ the factors of a_n are ± 1 and ± 2. Taking the factor -2, we find that $f(x)$ is exactly divisible by $x+2$. The test for each of the three other factors yields a remainder. Hence -2 is the only commensurable root.

Before we can apply Horner's method we must know the first significant figure of the root to be found. In other words, we must «locate» the root. This can always be done by Sturm's theorem, but usually the following theorem is more convenient. *If two real numbers a and b, when substituted for x in f(x), give to f(x) contrary signs, an odd number of roots of the equation $f(x)=0$ lies between a and b.* Thus, to locate the roots of $x^3-3x^2-46x-71=0$, substitute for x, in succession, the values -6, -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10. It is found that $f(-5)$ and $f(-4)$, $f(-2)$ and $f(-1)$, $f(8)$ and $f(9)$ are pairs of values of $f(x)$ having opposite signs. As there are three roots in all, we conclude that there is just one root between each of the pairs of values -5 and -4, -2 and -1, 8 and 9. To reduce the number of trials in more difficult examples, there are theorems on the upper and lower limits of roots which may be applied.

Horner's method consists of successive transformations of an equation. Each transformation diminishes the root by a certain amount. If the required root is 1.955, then the root is diminished successively by 1, .9, .05, .005. Synthetic division is employed. Suppose we desire to find, to three decimals, the root between -1 and -2 in the above example. It is convenient first to transform the equation so that the root becomes positive. We get $x^3+3x^2-46x+71=0$. The first significant figure in the root is 1. To diminish the roots by 1 we perform by synthetic division the following operation:

$$\begin{array}{rrrr|l}
1 & +3 & -46 & +71 & 1 \\
 & \underline{1} & \underline{+4} & \underline{-42} & \\
 & 4 & -42 & +29 & \\
 & \underline{1} & \underline{+5} & & \\
 & 5 & -37 & & \\
 & \underline{1} & & & \\
 & 6 & & &
\end{array}$$

The transformed equation, whose root under consideration now lies between 0 and 1, is $x^3+6x^2-37x+29=0$. This root being less than unity, x^2 and x^3 are less than x. Neglecting x^3 and $6x^2$, we obtain an approximate value for x from $-37x+29=0$, viz., $x=.7$. As in the process of ordinary long division or in the extraction of roots, so here the digit obtained by the first approximate division may be too large or too small and may need correction. An error of this sort will reveal itself later in the attempt to find the third digit of the root. Such correction is needed here. Actually $x=.9$. Diminish the roots of the last transformed cubic by .9, then find the third digit by the process just indicated for finding the second digit, then diminish the roots again, and so on. The entire operation is as follows:

$$\begin{array}{rrr|l}
1+3 & -46 & +71 & \underline{1.955} \\
\underline{1} & \underline{4} & -42 & \\
4 & -42 & +29 & \\
\underline{1} & 5 & \underline{-27.711} & \\
5 & -37 & +\ 1.289 & \\
\underline{1} & \underline{6.21} & -\ \underline{1.166625} & \\
6 & -30.79 & +\ \ .122375 & \\
\underline{.9} & 7.02 & & \\
6.9 & -23.77 & & \\
\underline{.9} & \underline{.4375} & & \\
7.8 & -23.3325 & & \\
\underline{.9} & .4400 & & \\
8.7 & -22.8925 & & \\
\underline{.05} & & & \\
8.75 & & & \\
\underline{.05} & & & \\
8.80 & & & \\
\underline{.05} & & & \\
8.85 & & &
\end{array}$$

The broken lines indicate the conclusion of the successive transformations. For advanced reading on the solution of numerical equations consult E. McClintock in ‘Am. Jour. of Maths.,’ vol. XVII, pp. 89–110; M. E. Carvallo, Résolution numérique complète d. Equations algébriques ou transcendantes,’ Paris, 1896; Karl v. Mor, ‘Anwendung der Horner'schen Methode zur Berechnung der imaginären Wurzeln numerischer Gleichungen,’ Innsbruck, 1884.

Multiple Roots.—Suppose that in $f(x)=0$ there are m multiple roots; that is, m roots are equal to each other. Then $f(x)=(x-r)^m\phi(x)$, and the first derivative is $f'(x)=(x-r)^m\phi'(x)+m(x-r)^{m-1}\phi(x)$. The fact that $f(x)$ and $f'(x)$ have the factor $(x-r)^{m-1}$ in common suggests the following rule for the discovery of multiple roots: Find the highest common factor of $f(x)$ and $f'(x)$. If that factor is $(x-r)^s$, then r occurs as a root $s+1$ times. If the highest common factor is $(x-r)^s(x-r_1)^t$, then r occurs as a root $s+1$ times and r_1 occurs $t+1$ times. If $f(x)=8x^3-20x^2+6x+9$, then $f'(x)=24x^2-40x+6$, and the H.C.F. is $2x-3$. Hence $\tfrac{3}{2}$ is a double root.

Elimination.—Take the equations,

$$f(x)=x^2+a_1x+a_2=0,$$
$$F(x)=x^2+b_1x+b_2=0,$$

and let r_1 and r_2 be the roots of the second equation. The necessary and sufficient conditions that the two equations shall have a root in common is that $f(r_1)$ or $f(r_2)$ shall vanish; that is, that the product $f(r_1)\cdot f(r_2)$ shall be zero. Multiplying together,

$$f(r_1)=r_1^2+a_1r_1+a_2,$$
$$f(r_2)=r_2^2+a_1r_2+a_2,$$

we get

$$r_1^2r_2^2+a_1(r_1r_2^2+r_1^2r_2)+a_2(r_1^2+r_2^2)$$
$$+a_1^2r_1r_2+a_1a_2(r_1+r_2)+a_2^2.$$

Expressing the symmetric functions of r_1 and r_2 in terms of the coefficients of the second of the given equations, we get $r_1^2r_2^2=b_2^2$, $r_1r_2^2+r_1^2r_2=-b_1b_2$, $r_1^2+r_2^2=b_1^2-2b_2$, $r_1r_2=b_2$, $r_1+r_2=-b_1$. Substituting these values, we have $b_2^2-a_1b_1b_2+a_2b_1^2-2a_2b_2+a_1^2b_2-a_1a_2b_1+a_2^2$.

This expression, involving the coefficients of the two given equations, is called the *eliminant* or *resultant*. Its vanishing is the condition that these equations have a root in common. More generally, if from n equations with $n-1$ variables we eliminate the variables and obtain an equation $R=0$, involving only the coefficients, the expression R is called the *eliminant* or *resultant* of the given equations.

In the above example the elimination was performed with the aid of symmetric functions. Of other methods of elimination the best known are those of Euler, Bezout, and Sylvester. We outline the last, known as Sylvester's Dialytic Method. To eliminate x between

$$f(x)=a_0x^n+a_1x^{n-1}+\ldots+a_n=0,$$
$$F(x)=b_0x^m+b_1x^{m-1}+\ldots+b_n=0,$$

multiply the first successively by x^0, x', x^2, $\ldots$, x^{m-1}, and the second successively by x^0, x', x^2, $\ldots$, x^{n-1}, and we obtain $m+n$ equations. The highest power of x is $m+n-1$. If $f(x)=0$ and $F(x)=0$ have a common root, it will satisfy all the $m+n$ equations. If the different powers of x, viz., x, x^2, $\ldots$, x^{m+n-1}, be taken as $m+n-1$ unknown quantities, satisfying $m+n$ linear equations, a relation will exist between the coefficients. This condition of consistency is the vanishing of the resultant. This resultant Sylvester expresses neatly in the form of a determinant. (See DETERMINANTS.)

Discriminants.—It has been shown that a multiple root of $f(x)=0$ is also a root of $f'(x)=0$. But the condition that these two equations have a common root is expressed by the vanishing of the resultant.

The resultant of $f(x)=0$ and $f'(x)=0$ is called the *discriminant* of $f(x)=0$. It may be otherwise defined as the simplest function of the coefficients, or of the roots, whose vanishing signifies that the equation has equal roots.

To the references already given, we add the following: 'Encyklopädie der mathematischen Wissenschaften,' Band I.; E. Netto, 'Vorlesungen über Algebra' (Leipzig, vol. I, 1896, vol. II, 1900); Serret, J. A., 'Cours d'Algèbre Supérieure' (Paris, 2 vols.); Todhunter, 'Theory of Equations' (London, 1880); H. Weber, 'Lehrbuch der Algebra' (Braunschweig, vol. I, 1898, vol. II, 1896); 'Encyklopädie der elem. Algebra und Analysis' (Leipzig, 1903); F. Cajori, 'Introduction to the Modern Theory of Equations' (New York, 1904).

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Equator, an imaginary great circle of the celestial vault or on the surface of the earth. As used in astronomy the term signifies a great circle of the celestial vault at right angles to its axis, and dividing it into a northern and a southern hemisphere. It is constituted by the plane of the earth's equator, produced in every direction till it reaches the concave of the celestial sphere. The sun is twice a year in the celestial equator—namely, at the equinoxes, whence the equator is also known as the equinoctial line, or simply the equinoctial (see EQUINOX). The point in the equator which touches the meridian is raised above the true horizon by an arc which is the complement of the latitude. The sun and planets all have equators. They rotate around their several axes, and the plane at right angles in each case is the equator of the heavenly body. In geography, the equator is a great circle on the surface of the earth equidistant from its poles, and dividing it into two hemispheres. Its latitude is zero; it is therefore marked on maps as 0. Other parallels of latitude are counted from it, augmenting in their numerical designation as their distance from it north or south increases, the poles being 90°. The plane of the terrestrial equator is a plane perpendicular to the earth's axis and passing through its center. The magnetic equator is a somewhat irregular line, nearly but not quite a great circle of the earth, in which there is no dip of the magnetic needle. It is hence called also the aclinic line. It is inclined to the horizon at an angle of 12°, and cuts it at two points almost exactly opposite to each other, the one in the Atlantic and the other in the Pacific. It is not far from the geographical equator, but its situation slowly alters year by year, there being a slow oscillation of the magnetic poles, while the geographical equator and poles are fixed.

Equato'rial ("of the equator"), a geographical and astronomical term. In astronomy it is usually applied to a telescope so mounted as to have a motion in two planes at right angles to each other; one parallel to the axis of the earth, and the other to the equator. Each axis has a graduated circle, one for measuring declination and the other right ascension. Clockwork is sometimes attached to the instrument to give the motion in right ascension, and thereby keep the object constantly in the field of the instrument. See ASTRONOMY.

Equatorial Coudé ("Elbow Equatorial"), a form of equatorial telescope invented by Loewy, of the Paris Observatory. The observer can remain stationary in a comfortable position, with a desk-table built around the eye-piece end, and can have all this part enclosed from the cold, and warmed if desired, at the same time commanding the whole heavens without rising from his chair. See ASTRONOMY; TELESCOPE.

Equatorial Current. See CURRENTS, *Marine*

Equerry, ĕk'wĕ rĭ or ē-quer'ĭ, an officer of the royal household of Great Britain in the department of the master of the horse. There are six equerries, who are in attendance monthly, one at a time, their principal duty being to precede the sovereign in a coach, when the ruler rides abroad in state. The clerk-marshal, as the chief equerry is styled, has a salary of £500 per annum, and the equerries in ordinary £300.

Equestrian Order, or **Equites,** the order of knights in ancient Rome. The equites or knights originally formed the cavalry of the army. They are said by Livy to have been instituted by Romulus, who selected 300 of them from the three principal tribes. Soon after the first Punic War the equites became a distinct order in the state, and the juries and the farmers of the revenue were selected from their ranks. They held their position in virtue of a certain property qualification, and toward the end of the republic they possessed much influence in the state. They had particular seats assigned to them in the circus and theatre, and the insignia of their rank, in addition to a horse, were a gold ring and a tunic with two narrow purple stripes. Their privileges were curtailed by Sulla and under the later emperors the order disappeared from the stage of political life.

Equidæ, ĕk'wĭ-dē, the horse family, the most highly specialized of the perissodactyl ungulates, characterized by the fact that only one toe (the third) in each foot is now functional, traces («the splint bones») remaining of the two other toes (the second and fourth) in the «splint bones» hidden beneath the flesh on each side of the shank of the foot. (For the relationships of this family to the titanotheres, tapirs, and rhinoceroses, see UNGULATA; and for the evolution of the characteristic foot-structure see HORSE; EVOLUTION OF.) The family contains but a single genus (*Equus*), structural distinctions not being of sufficient importance to separate generically the modern horses from several extinct species, or from the asses or zebras, or these from each other. Apart from the dependence upon a single toe, the family is characterized by the facts that the orbit is completely surrounded by bone; the incisor teeth are chisel-shaped; the canines or «tushes» are rudimentary (when present), and the premolars (except the first or «wolf tooth») resemble the hypselodont molars. Externally the members of this family are robust, with comparatively slender limbs, the feet «booted» in a single horny hoof, encasing the terminal phalanx; the body thickly clothed with short close hair, which, however, becomes longer, and in some species profuse, forming a mane, on the nape and tail. The colors are apt to be disposed in dark stripes on a yellow or brownish ground, most strikingly in the zebras, but traceable in most others. There are never any horns, and speed is depended on to escape from enemies which cannot be beaten off by kicking with the hind feet, while struggles between rival males for the leadership of the bands of mares are carried on mainly by biting and striking with the fore feet. The fore-limbs, or both pairs, have a callous pad upon the inside, «which,» says Beddard, «is possibly to be looked upon as an aborted gland, probably originally of use as secreting some odorous substance calculated to enable strayed members of the herd to regain their companions.» The whole structure of the equidæ has been developed in adaptation to a life upon open dry plains, where ability to travel with rapidity and to live upon grass and herbage has been perfected to a high degree. The stomach has no such complicated arrangement for the assimilation of this comparatively innutritious diet as has been acquired by the ruminants (q.v.). The alimentary canal is of great length (about eight times the length of the body); and the stomach, simple in form, is divided into a cardiac, and a pyloric part, sharply distinguished by the dense epithelium lining of the former. The cæcum is twice as large as the stomach, and there is no gall-bladder. The teats are two in number and situated in the groin. One or two foals are produced at a birth after a gestation of about 11 months. All the species are gregarious and polygamous; and like most such animals are readily tamable, though the zebra has proved somewhat intractable and useless to mankind.

The family in the course of its history has occupied all the larger land-areas of the globe except Australia; but although its ancestors abounded in both Americas in the past, and modern horses run wild have multiplied and flourished exceedingly upon their grassy plains, no living species inhabited the New World. In the Old World the horse or horses and one of the asses were Asiatic and European; a second species of ass and the various zebras were wholly African. See ASS; HORSE; QUAGGA; ZEBRA.

Equilib'rium, a state of equipoise, produced by the mutual counteraction of two or more forces; as the state of the two ends of a lever or balance when both are charged with equal weight. Equilibrium is characterized by three phases. When a body suspended by a string, for example, on being slightly moved out of any position, always tends to return to its position, that position is said to be one of *stable equilibrium;* when a body like a stick or other object balanced on its point will not thus return to its previous position, its position is said to be one of *unstable equilibrium;* and when a body such as a sphere resting upon a horizontal plane will rest in any position in which it is placed, it is said to be of *neutral* or *indifferent equilibrium.*

Equilibrium, in physiology, the ability to maintain the body by proper muscular force under nervous control, so that it can perform co-ordinated movements, or resist the force of gravity. By equilibrium is here meant the control of the body in the upright position, apart from the localized processes of co-ordination. Loss of equilibrium shows itself particularly in walking and running. Here the centre of gravity of the body is constantly changing and the ability of the individual to hold himself erect depends upon a number of features. The eye, the tactile sense of the feet, the joint-senses, the muscular sense that weighs the various muscular movements, and the higher cerebral centres are all involved, and loss of equilibrium or inco-ordination may result from disease or injury to any of these functions. Loss of eyesight does not necessarily involve any loss of equilibrium, but loss of tactile sense of the feet, such as is seen in locomotor ataxia, or in people who have had their feet frozen, almost invariably produces a loss of equilibrium. In the same disease (locomotor ataxia), and in forms of neuritis, the loss of muscular sense and joint-sense produces similar phenomena. For the higher cerebral centres of control there is good reason to believe that the semicircular canals in the internal ear constitute a special sense-organ for the determination of the direction of the movements of the head which are so essential in the preservation of general equilibrium. Diseases of the semicircular canals are frequently accompanied with dizziness and vertigo. It also seems probable that certain areas in the cerebellum are closely associated with the equilibrium. See CEREBELLUM; INCO-ORDINATION; LOCOMOTOR ATAXIA.

Equilibrium, Chemical. In mechanics a system is said to be in equilibrium when the forces that act upon it are precisely balanced, so that their resultant is everywhere zero. A system is similarly said to be in chemical equilibrium when its state is such that there is no tendency toward a sensible chemical change, in any of its parts. The absence of chemical action may be absolute, or merely apparent. In other words, there may be no chemical changes going on at all, or there may be opposite changes going on simultaneously, in such a way that no resultant modification can be observed in any part of the system, however small the part selected for observation may be. In the latter case the existence of the simultaneous and opposite reactions can only be indirectly inferred from a study of the system when it is not in equilibrium.

According to the theory of chemical affinity that was held before the importance of mass-action was understood, two substances either would combine or would not, according as their «affinities» were more or less completely satisfied in the combined state, or in the uncombined state. That this view is entirely inadequate to explain the facts of chemistry is made evident by the following simple example: When steam is passed over red-hot iron filings, it is decomposed into oxygen and hydrogen, the iron absorbing the oxygen with the formation of oxide of iron, while the hydrogen escapes in the free state; but if hydrogen is passed over red-hot oxide of iron, the oxide is reduced to the metallic state, its oxygen combining with the hydrogen to produce steam, which passes on in the hydrogen current. This apparent contradiction may be best explained by assuming that when a mixture of steam and hydrogen is in contact with a red-hot mixture of iron oxide and metallic iron, both of the foregoing reactions take place simultaneously. If the metallic iron and the steam are present in excessive amounts, the resultant action will be, on the whole, the oxidation of the iron and the decomposition of the steam; while if the iron oxide and the hydrogen are present in excess, the resultant action will be the reduction of the oxide to the metallic state, and the simultaneous formation of steam. It is therefore apparent that in some reactions, at any rate, the relative masses in which the various constituents are present must be considered with much care, before any prediction of the chemical deportment of the mixture can be made. Attention was first directed to this fact by Claude Louis Berthollet ('Essai de statique chimique,' 1803). In the example cited above, if the iron, iron oxide, hydrogen, and steam were left in contact in a closed vessel, a state of apparent equilibrium would be finally attained, in which the formation and decomposition of the steam would occur with equal rapidity, so that no visible change would take place thereafter. When this state of «chemical equilibrium» is attained, the abstraction of hydrogen or of iron oxide, or the addition of steam or of metallic iron, will destroy the equilibrium, and more iron will be oxidized, until a new state of equilibrium is established. Similarly, the abstraction of steam or of metallic iron, or the addition of hydrogen or of iron oxide, when the system is in equilibrium, will be followed by the reduction of a portion of the iron oxide, and the establishment of a new state of equilibrium. According to Berthollet, all reactions are fundamentally of this kind. When sodium chloride is added to a solution of silver nitrate, we know that the silver is all thrown down in the form of an insoluble chloride. In this case, Berthollet would consider that the sodium chloride, sodium nitrate, silver chloride, and silver nitrate tend toward a state of chemical equilibrium, but that since the silver chloride is continually removed from the solution by reason of its insolubility, it is impossible for the state of equilibrium ever to be attained, just as it would be impossible for such a state to be attained in our previous illustration if one of the constituents (say the iron oxide) were removed, or rendered inactive in any way, as fast as it were formed.

The ideas of Berthollet have been found to be sound in their essentials, and they have served as the foundation stones for the modern theory of chemical action, though their full development cannot be explained without the use of the differential calculus. The basis of the theory of mass-action, so far as solutions are concerned at all events, appears to be substantially as follows: Two substances in solution cannot combine with each other, except when a molecule, or ion (see SOLUTION) of the one, in its wandering through the solution, chances to encounter a molecule or ion of the other. Now while we do not know the actual number of encounters that take place in a given time between molecules of different kinds, we do know that in a homogeneous solution the chance that any one given molecule of the first kind will encounter some molecule of the second kind within (say) the next second, is strictly proportional to the number of molecules of the second kind that are present in the solution; and conversely, the chance that any given molecule of the second kind will encounter some molecule of the first kind, within the next second is strictly proportional to the number of molecules of the first kind that are present. Since the number of molecules of each kind that are present in an actual solution is practically infinite, this amounts to saying that the actual number of encounters between molecules of different kinds, in one second, is proportional to the product of the numbers of molecules of the first and second kinds that are present. As an illustration of the usefulness of this principle, we may consider the equilibrium of a mixture of acetic acid and ethyl alcohol. Some of the acid combines with some of the alcohol to form water and ethyl-acetic ester (see ESTER), but the reaction is never complete, since a state of equilibrium is attained after a time, in which the inverse combination takes place just as fast as the direct one. The molecular weight of acetic acid ($CH_3COO.H$) is 60, that of ethyl alcohol (C_2H_5OH) is 46, that of ethyl-acetic ester or ethyl acetate ($CH_3COO.C_2H_5$) is 88, and that of water (H_2O) is 18. A mass of any substance which contains as many grams as there are units in the molecular weight of the substance is known as a «gram-molecule» of the substance. This name is rather unhappily chosen, but the idea itself is a useful one, and is commonly employed in modern writings upon theoretical chemistry. Let us suppose that one gram-molecule of acetic acid (60 grams) is originally mixed with M gram-molecules of ethyl alcohol (46M grams), and with N gram-molecules (18M grams) of water, and let us inquire what the composition of the mixture will be when the state of final chemical equilibrium has been attained. The advantage of taking the gram-molecule as the unit of mass is, that when this unit is used the number of grams of acetic acid, alcohol, and water that are originally present will be proportional to 1, M and N, and we may speak of M and N, and write them in our equations precisely as though they were really the number of actual molecules present. The acetic acid and alcohol act upon each other as indicated by the equation $CH_3COO.H + C_2H_5OH = CH_3COO.C_2H_5 + H_2O$. Now let us assume that when the state of equilibrium has been attained, X gram-molecules of the alcohol have been decomposed. This implies that X gram-molecules of the acetic acid have also been decomposed, and that X gram-molecules, each, of water and of ethyl acetate have been formed. The total numbers of gram-molecules of the various substances that are present when the final state of equilibrium is attained are therefore as follows: Acetic acid, $1 - X$; alcohol, $M - X$; water, X; ethyl acetate, $N + X$. The number of molecular collisions per second, in which a molecule of acetic acid encounters a molecule of alcohol, is therefore (in the final state) proportional to $(1 - X)(M - X)$; and since the chemical action is itself proportional to the number of such collisions, we may assume that the number of gram-molecules of ethyl acetate formed per second, in the state of equilibrium, is $A(1 - X)(M - X)$, where A is a constant whose value we do not know. The same line of reasoning shows that the number of gram-molecules of ethyl acetate that are lost from the solution, in the same time, through combining with water to reproduce acetic acid and alcohol, is $B(N + X)X$, where B is another constant, whose value is also unknown. Since the existence of equilibrium requires that the quantity of ethyl acetate present shall be constant, we have $A(1 - X)(M - X) = B(N + X)X$. Now it is known by experiment that when the original mixture is free from water, and contains chemically equivalent amounts of acetic acid and alcohol, so that $M = 1$ and $N = 0$, the state of final equilibrium is attained when $X = \frac{2}{3}$. If these values of M, N and X are substituted in the foregoing equation, we find that A and B are connected by the necessary relation $A = 4B$. If we replace A by 4B and then divide through by B, the foregoing equation reduces to $4(1-X)(M-X) = (N+X)X$, or $3X^2 - (4 + 4M + N)X + 4M = 0$, a quadratic equation from which the value of X (that is, the number of gram-molecules of acetic acid decomposed) may be inferred, in the final state of equilibrium, for any desired initial mixture of acetic acid, alcohol, and water. This example has been given at some length, both because it illustrates clearly the principles of chemical equilibrium and the law of mass-action, and because reactions of this very kind, in which esters are formed by the direct action of an acid upon an alcohol, have a special historic interest, since their study has contributed in no small measure toward placing the modern theory of chemical equilibrium upon a firm foundation.

When it is desired to determine the state of a chemical system after the lapse of a definite interval from an initial instant for which its state is given, we must form a differential equation in which the condition is expressed that the chemical change, per unit of time, is proportional (as above) to the product of the number of gram-molecules of the reacting substances that are present at the instant considered; and having formed this equation and integrated it, we obtain an expression in which the composition of the system is expressed as a function of the time. When several substances that may react upon one another are present, the differential equation is more complicated in form, as might be expected; but for details of this sort reference must be made to works on theoretical chemistry. When the system contains several acids and one or more bases, the distribution of the bases among the various acids may be investigated in accordance with similar principles, and by comparing the numerical results that are thus obtained with the facts of observation, estimates of the true relative «affinities» of the acids may be had.

When, as is often the case, the course of a reaction depends upon the temperature, the principles of mass-action apply as before, but regard must also be had for the laws of thermodynamics (q.v.), which usually impose certain limitations upon the equations. The full theory of chemical changes in which thermodynamical considerations play an important part was given by J. Willard Gibbs, in a paper of great power and originality entitled 'On the Equilibrium of Heterogeneous Substances,' published in the 'Transactions of the Connecticut Academy of Arts and Sciences' for 1875. This paper is exceedingly difficult reading on account of its generality, but it contains the germs of many discoveries that were made years afterward. Consult: Nernst, 'Theoretical Chemistry.'

Equine Antelope. See Blaubok.

Equinoc'tial, in astronomy, synonymous with equator. When the sun is on the equator there is equal length of day and night over all the earth: hence the name equinoctial. See Equator; Equinox.

Equinoctial Gale, a gale popularly supposed to occur at the time of the spring or autumn equinox. See Equinox.

Equinoctial Points are the two points wherein the equator and ecliptic intersect each other; the one, being the first point of Aries, is called the vernal point; and the other, in the first point of Libra, the autumnal point. See ECLIPTIC; EQUINOX; EQUINOXES, PRECESSION OF THE.

Equinovalgus. See DEFORMITIES.

Equinovarus. See DEFORMITIES.

E'quinox, in astronomy, is that time of the year when the day and night are equal: the length of the day is then 12 hours; the sun is ascending 6 hours, and descending the same time. This is the case twice a year, in spring and in autumn, when the sun is on the equator. When the sun is in this situation the horizon of every place is divided into two equal parts by the circle bounding light and darkness; hence the sun is visible everywhere 12 hours, and invisible for the same time in each 24 hours. The vernal equinox is on 21 March, and marks the beginning of spring; the autumnal is on 23 September, which is considered the commencement of autumn; at all other times the length of the day and of the night are unequal, and their difference is the greater the more we approach either pole, and in the same latitude it is everywhere the same. On the equator this inequality entirely vanishes; there, during the day, which is equal to the night, the sun always ascends six hours and descends six hours. In the opposite hemisphere of our earth the inequality of the days increases in proportion to the latitude: the days increase there while they diminish with us, and *vice versa.* The points where the ecliptic intersects the equator are called equinoctial points. The vernal equinoctial point was formerly at the entrance of the constellation of Aries; hence the next 30 degrees of the ecliptic, reckoned eastward from it, have been called Aries; but this point long ago deserted the constellation of Aries, and now stands in Pisces; for it is found by observation that the equinoctial points, and all the other points of the ecliptic, are continually moving backward or westward; which retrograde motion of the equinoctial points is what is called the precession of the equinoxes. It appears from the result of calculations that the path of either of the poles is a circle, the poles of which coincide with those of the ecliptic, and that the pole will move along that circle so slowly as to accomplish the whole revolution in about 25,800 years nearly. The diameter of this circle is equal to twice the inclination of the ecliptic to the equator, or about 47°. Now, as the ecliptic is a fixed circle in the heavens, but the equator, which must be equidistant from the poles, moves with the poles, therefore the equator must be constantly changing its intersection with the ecliptic. And from the best observations it appears that the equator cuts the ecliptic every year 50.25" more to the westward than it did the year before; hence the sun's arrival at the equinoctial point precedes its arrival at the same fixed point of the heavens every year by 20 minutes 23 seconds of time, or by an arc of 50.25". Thus, by little and little, these equinoctial points will cut the ecliptic more and more to the westward, till, after 25,800 years, they return to the same point. See DAY; ECLIPTIC; EQUATOR.

Equinoxes, Precession of the, the motion of the equinoxes along the ecliptic due to the change in the direction of the earth's axis of rotation, caused by the attraction of the moon and sun on the protuberant equatorial ring of the earth. See EQUINOX.

Equiseta'ceæ. See *Equisetales* under FERNS AND FERN ALLIES.

Equise'tum. See *Equisetales* under FERNS AND FERN ALLIES.

Equites, ĕk'wĭ-tēz. See EQUESTRIAN ORDER.

Equity is "that system of justice which was administered by the high court of chancery in England in the exercise of its extraordinary jurisdiction." Bispham, 'Principles of Equity.'

In England, prior to the American Revolution, the courts were divided into courts of law and courts of equity. In the law courts the parties were compelled to proceed strictly according to the law and the practice, and the forms of pleading were so intricate that many cases were decided on the pleadings without the merits of the case ever being heard; and often when the cause was heard it was impossible to administer justice on account of the form of action, the parties to the action, and the cause of action on which suit had been brought. In the courts of equity they were not restricted by the technical pleadings; amendments could more readily be granted; the parties to the action could be changed by either dropping some or adding others; and the decree could be framed to meet the particular question involved, so that justice would be done to all the parties interested.

After the Revolution the States adopted the English system; but while some of them have kept strictly to that system and have had distinct courts of law and of equity, other States have law and equity administered by the same judges and courts, at one time sitting as courts of law and at another time as courts of equity.

Some of the rules and maxims of equity are: "Equity considers that as done which ought to be done." "Equity acts *in personam.*" "He who comes into equity must do so with clear hands." "Between equal equities priority of time will prevail." "Between equal equities the law will prevail." "No right without a remedy." "When a court of equity has once acquired jurisdiction of a cause it will continue to act until the matter is finally disposed of."

Equity is divided into three great classes or divisions: Equitable titles, equitable rights, and equitable remedies. Equitable titles are those which are recognized only by a court of equity, as where, when a person gave value for a chose in action which was assigned to him, the assignment was not recognized at law, as it would violate the rules against champerty and maintenance, but equity allows the assignee to bring suit in the name of the assignor. Equitable rights arise where a guardian enters into a transaction with his former ward a very short time after the ward has obtained his majority. If within a reasonable time the ward returns what he received from the guardian the guardian will, in equity, be compelled to return the property to the ward. Equitable remedies arise in those cases in which the law recognizes a right but cannot enforce it, as where a contract is made for the sale of a piece of property, if the seller refuses to convey, the purchaser's remedy at law is for damages for breach of the contract; but in equity the court will decree specific performance. Generally this applies only to real estate, because if it is personal property, after the damages are recovered other personal property of the same kind can be purchased; but if the personal property is of such nature that it cannot be duplicated, such as a painting by a particular artist, equity will affirm relief in the way of specific performance.

Suits in equity are commenced by a bill or petition. The bill may be amended, or, if the proceeding have gone too far for that, a supplemental bill may be filed. The defense is by demurrer, plea, or answer. The judgment of the court is called a decree, and the relief granted is such as to affect all the parties, and is adapted to the facts and circumstances of that particular case. The general rules of evidence are the same as in a proceeding at law, but the answer to the bill, if made under oath, is evidence for the defendant in so far as it is responsive to the bill.

Equity, Courts of. See COURT.

Equity of Redemption. Upon a mortgage, although the estate, upon non-payment of the money, becomes vested in the mortgagee, yet equity considers it only a pledge for the money, and gives the party a right to redeem, which is called his equity of redemption. If the mortgagee is desirous to bar the equity of redemption he may oblige the mortgagor either to pay the money or be foreclosed of his equity, which is done by proceedings in chancery by bill of foreclosure. See CHANCERY; EQUITY; FORFEITURE; MORTGAGE; REDEMPTION.

Equiv'alent, having equal value, power, area, or volume. As the quantities by weight of bodies which combine with hydrogen, oxygen, and one another are fixed, there is always one simplest proportion in which they can be regarded as combining with or substituting one another. This quantity was called by Dalton the atomic weight, because he considered these proportions as the comparative weights of the atoms, or ultimate particles of the bodies. The term, however, was regarded as hypothetical, and both combining proportion and equivalent were proposed instead. The latter, which was suggested by Dr. Wollaston, was accepted, and was till quite recently applied to elements and compounds. It has been shown, however, that quantities were thus styled equivalent which were not so in any sense of the term. Thus, while one part by weight of hydrogen combines with 8 of oxygen, and 8 of oxygen with 14 of nitrogen, this quantity of nitrogen combines not with 1 but with 3 of hydrogen. Strictly, therefore, the quantity of nitrogen equivalent to 1 of hydrogen is 4⅔. The older equivalent notation was consequently irregular and unsystematic,— equivalents being used in some cases but not in others. Hence has arisen the modern use of the word, in which it is expressly distinguished from the combining proportion or atomic weight. The latter is the number which best denotes the proportion in which the substance reacts chemically with all other bodies, and which is fixed by reference not to mere proportional weight, but also to vapor density, specific heat, crystalline form, diffusion, etc.; physical phenomena, in which certain relations are so constant that they presumably indicate natural laws. The former simply denotes the proportion by weight in which a body combines with or replaces a unit of hydrogen. See CHEMISTRY.

Equuleus, ĕ-kwoo'lē-ŭs, in astronomy (“the Colt” or “Little Horse”), one of the 48 original constellations of the Almagest, situated just between the head of Pegasus and Delphinus. It has Aquarius on its south side. It is a very inconspicuous constellation, its brightest star being of the fourth magnitude. Also a name given to the rack, or instrument of torture.

Era. See CHRONOLOGY; EPOCH.

Era of Good Feeling, 1817–23. In American political history, Monroe's two administrations, up to the canvass for his successor. There were practically no issues, and but one party. The issue on which the Federalist party was founded had long since been appropriated by the Democrats, and it had foolishly taken theirs in exchange; the embargo and the war had created a sectional issue, but the peace ended that and left absolutely no pretext for division. The Hartford Convention (q.v.) had killed the old leaders politically; the new ones had joined the Democrats, because the embargo and the war had driven New England capital from commerce into manufactures, and it wished to demand tariff favors from the administration. But it was a decade before the tariff and internal improvements, the next division lines, assumed theoretic consistency. Monroe issued an inaugural in 1817 especially to placate the Federalists; and followed it by a tour through New England where he was received with immense ovations from both parties. He was unanimously re-elected in 1820, save for the whim of one elector who did not object to him. The personal factions which contested the field in 1824, the coalition (q.v.) which decided the result, and the Jacksonians' fury over it, effectually ended the good feeling.

Eragros'tis, a large genus of the grass family, represented in America by about 30 species, either native or naturalized. The species are from a few inches to several feet in height, and are found in nearly all parts of the United States. None are of commercial importance, and such as are used for hay are accidental growths among cultivated grasses. The strong-scented eragrostis (*E. major*), is an ill-smelling grass, but tall, erect, and rather handsome, owing to the shape and size of its leaves. It is found in almost every part of the United States and Ontario, naturalized from Europe.

Erard, ā-răr, **Sebastien,** French musical instrument maker: b. Strasburg 5 April 1752; d. Passy, near Paris, 5 Aug. 1831. He went to Paris at 18, and with his brother, Jean Baptiste, produced pianofortes so superior to any previously made in France that his fame quickly spread, and orders flowed in upon him from all quarters. During the Revolution he went to England and established a manufactory in London, and when peace was restored his life was passed between that city and Paris. His improvements upon the harp, more especially that of the double movement, the principle of which he afterward communicated to the piano, entitle him to high merit as an inventor.

Erasistratus, ĕr-ạ-sĭs'trạ-tŭs, Greek physician. He lived in the 3d century before the Christian Era. He was the court physician of Seleucus Nicator, king of Syria, and rendered himself famous by the sagacity with which he discovered the malady of Antiochus, the king's son. He subsequently went to Alexandria, where he devoted himself to the study of anatomy. He was the first who systematically dissected the human body, and his description of the brain and nerves is much more exact than any given by his predecessors. He classified the nerves into nerves of sensation and of locomotion, and it is said had almost stumbled upon the discovery of the circulation of the blood. He was remarkably averse to blood-letting and the giving of purgatives, relying chiefly upon diet and regimen, bathing, exercise, friction, and the most simple articles of the vegetable kingdom, for the restoration and preservation of health. He wrote several works on anatomy, practical medicine, and pharmacy, of which only the titles remain, together with a great number of short fragments preserved by Galen and other ancient medical writers.

Erasmus, ĕ-răz'mŭs, **Saint**, Syrian bishop and martyr. He was put to death under Diocletian by disemboweling, and his martyrdom is frequently represented in art. As he was counted as one of the 14 Succorers of the Distressed, so was his aid especially invoked in affections of the stomach. The remaining 13 Succorers are Saints Acasius, Blasius, Christopher, Cyriacus, Dionysius the Areopagite, Egidius, Eustathius, George the Martyr, Pantaleon, Vitus, Barbara, Catharine, and Margaret.

Erasmus, Desiderius, Dutch scholar: b. Rotterdam probably 28 Oct. 1467; d. Basel, Switzerland, 12 July 1536. He was the illegitimate son of one Gerhard of Gouda. The name by which he is known is merely the Latin and Greek rendering of Gerhard, Desiderius the Latin, and Erasmus, or, more correctly, Erasmius, the Greek equivalent. He was a singing-boy in the Cathedral of Utrecht till his 9th year, then entered the school at Deventer, where he displayed such brilliant powers that it was predicted that he would be the most learned man of his time. At the age of 17 he assumed the monastic habit, but the bishop of Cambray delivered him from this constraint by taking him as a secretary. In 1492 he traveled to Paris to perfect himself in theology and polite literature, and there became the instructor of several rich Englishmen, from one of whom — Lord Montjoy — he received a pension for life. He accompanied them to England in 1497, where he was graciously received by the king. He returned soon after to Paris, and then traveled into Italy to increase his stock of knowledge. He now asked a dispensation from the vows of his order, which the Pope granted him. He visited Venice, Padua, and Rome; but brilliant as were the offers here made him, he preferred the invitation of his friends in England. When he visited the lord-chancellor, Sir Thomas More, without making himself known to him, the chancellor was so delighted with his conversation that he exclaimed, «You are either Erasmus or the devil.» He was offered a benefice, but was unwilling to fetter himself by an office of this kind. He was for a short time professor of Greek at Oxford. He afterward traveled through Germany and the Netherlands, and went to Basel, where he had his works printed by Froben.

To profound and extensive learning Erasmus joined a refined taste and a delicate wit. Naturally fond of tranquillity and independence, he preferred the pleasure of literary ease and retirement to the pomp of high life. His caution and worldly prudence offended many of the best men of his times, but he did great and lasting service to the cause of the revival of learning. Like many notable men of his day who recognized the need of reforming ecclesiastical abuses, he sympathized with the beginnings of the Reformation, but repudiated it when it went to the excess of rebellion. He wished for a general ecclesiastical council, to be composed of the most learned and enlightened men, but had not the satisfaction of seeing his wish accomplished. What he did to serve the world was effected by his writings, which will always be prized for their interesting matter and graceful style. Besides his editions of various classics, the first edition of the Greek Testament from MSS. (with Latin translation), and his other philological and theological writings, may be only mentioned his well-known book in praise of folly 'Encomium Moriæ,' and his 'Colloquies.' His letters are very valuable in reference to the history of that period. See Lives by Knight (1726); Jortin (1748); Burigny (1752); Durand de Laur (1874); Feugère (1874); Drummond (1873); Froude (1894).

Eras'tians, in England, a name applied to a party that arose in the 17th century, denying the right of autonomy to the Church — a right neither maintained nor denied by Erastus. The Erastian controversy broke out at the time of the Westminster Assembly. The leading Erastians in that assembly were Lightfoot and Coleman, who were supported by Selden and Whitelocke in the House of Commons. Since the time of the Reformation the controversy has been confined chiefly to the Church in Scotland.

Eras'tus, Thomas (properly LIEBLER or LIEBER), German theologian and physician: b. Auggen, near Mühlheim, 1524; d. Basel, Switzerland, 1583. He studied theology at Basel (where he Græcized his name), and philosophy and medicine at Bologna and Padua. After nine years in Italy, he was appointed physician to the counts of Henneberg; then professor of medicine at Heidelberg, and court-physician to the elector palatine. He removed from Heidelberg to fill the chair of medicine at Basel in 1580. Shortly before his death he had been appointed professor of ethics. Erastus was a skilful physician and a man of upright character, an equally vigorous writer against «the new medicine of Philip Paracelsus» (1572) and in favor of the burning of witches (1577 et seq.). In theology he was a follower of Zwingli, and his fame now rests on his strenuous opposition to Calvinist discipline and Presbyterian order. Erastus was excommunicated on a false suspicion of heresy, founded on a correspondence with Unitarians of Transylvania, but was restored in 1575. His chief work is a treatise on excommunication entitled: 'Explicatio gravissimæ quæstionis utrum Excommunicatio . . . mandato nitatur divino, an excogitata sit ab hominibus.' This was answered by Beza in his 'De vera Excommunicatione et Christiano Presbyterio' (1590). Erastus maintained that no member of the Church should be excluded from her communion as a punishment for sin. Punishment is «the special duty and office» of the civil magistrate. See Bonnard, 'Thomas Eraste et la discipline ecclésiastique' (1894).

Erato, ĕr'ạ-tō (Gr. *eraō,* I love), one of the nine Muses, whose name signifies loving, or lovely. She presides over the songs of lovers, and touches, as Ovid, in his 'Art of Love,' informs us, the hearts of the coldest maidens by her tender lays. (See MUSES.) Erato is also the name of one of the planetoids.

Eratosthenes, ĕr-ạ-tŏs'thē-nēz, Alexandrian astronomer, geographer, and philosopher: b. Cyrene, Africa, 276 B.C.; d. about 196 B.C. He became librarian at Alexandria, and improved the science of mathematical geography, which he reduced to system, but gained his greatest renown by his investigations of the size of the earth, his estimate of the circumference of which was surprisingly near the truth. He wrote also on chronology, grammar, etc. and was considered no mean poet. He rendered much service to astronomy and first observed the obliquity of the ecliptic. He is said to have starved himself to death after becoming blind. The extant fragments of his writings were collected by Bernhardy in his 'Eratosthenica' (1822); his geographical fragments were published by Berger in 1880.

Er'ben, Henry, American naval officer: b. New York September 1832. He was graduated at the United States Naval Academy in 1854; became commander in 1868; rear-admiral in 1894; and was retired in the latter year. During the Civil War he served with Admiral Farragut in the Gulf of Mexico and on the Mississippi River with Admiral Dupont, etc. In 1866–9 he was on duty in South America; later, in command of the Tuscarora, he made deep-sea soundings in the Pacific; afterward commanded the Pensacola in a trip round the world; and in 1891–2 was commandant of the New York Navy Yard.

Er'bium, a rare metallic element, occurring in the form of a tantalate or silicate in the minerals gadolinite, fergusonite and euxenite, and as a phosphate in the mineral xenotime. It has the chemical symbol Er, or E, and an atomic weight of about 166. The oxide of erbium, Er_2O_3, has a pale rose color, is infusible, and, when strongly heated glows with a brilliant green light. It is not affected by water, but dissolves slowly in hot acids with the formation of the corresponding erbium salts. Most of the salts are rose-colored, and the haloid compounds are also deliquescent. The name erbium is derived from Ytterby, Sweden, where the mineral gadolinite is found. The recognition of erbium as a new element is attributed to Mosander (1843); but the metal itself has not yet been isolated.

Er'cildoune, Thomas of (called the Rhymer, and Learmont), a Scottish poet and seer, who flourished probably between 1220 and 1297, and wrote a poem called 'Sir Tristrem.' He occupies a very conspicuous position in the annals of Anglo-Saxon literature, but not very much is known of his life, and there is even some dispute respecting his authorship of various pieces attributed to him.

Ercilla y Zuniga, ār-thēl'yä ē thoo-yē'gā, **Alonzo de,** Spanish soldier and poet: b. Madrid 7 Aug. 1533; d. there 29 Nov. 1594. An insurrection breaking out among the Araucanians, a tribe of Indians on the coast of Chile, Ercilla joined an expedition sent against them. The difficulties the Spaniards had to encounter, the heroic resistance of the natives, and the multitude of gallant deeds by which the war was signalized, inspired the young and brave Ercilla with the idea of making it the subject of an epic poem, to which he gave the name of 'La Araucana.' He returned to Spain after having finished the first part of his epic. In 1570 he married Maria Bazan at Madrid, whose charms and virtues are celebrated by him in various passages of his poem. In 1569 the first 15 cantos of his poem, in 1578 a second, and in 1590 a third part were added, making in all 37 cantos; he did not live, however, to complete the work, but died in great poverty and obscurity. The 'Araucana' is an historical epic in the octave measure, in which the author confines himself, with the exception of some episodes and a few fictions, to the exact historical course of events. Hence the poem often assumes almost the character of a chronicle. Lope de Vega has taken from the epic of Ercilla the materials for his piece 'Arauca Conquered.' The best editions are those published at Madrid in 1776 and 1828. It has been translated into Italian, and twice into French. See ARAUCANIANS.

Erckmann-Chatrian, ĕrk'män - shä-trē-än', the combined surnames of two Frenchmen, natives of Alsace, who collaborated in writing romances. EMILE ERCKMANN: b. Phalsbourg 20 May 1822; d. Paris 14 March 1899. Having completed his studies in the communal college of his native town, he went to Paris in 1842 to study law. Returning to Phalsbourg in 1847 because of a serious illness, he began to turn his attention to romance writing during his convalescence. It was about this time (1848) that he met his collaborateur, LOUIS GRATIEN CHARLES ALEXANDRE CHATRIAN, b. Soldatenthal 18 Dec. 1826; d. Raincy 5 Sept. 1890. Chatrian's father was a glass-blower, and it was intended that he should follow the same craft. Instead of doing so, however, he left his native village and became a teacher in Phalsbourg, where he made the acquaintance of Erckmann. For several years the stories produced by this co-partnership were published in obscure newspapers, both in Strasburg and Paris, but about 1860 their graphic romances of eastern France in the time of Napoleon I. gained a rapid popularity. Their success was continued in a series of which the best known are: 'Le Fou Yégof' (1862); 'L'Ami Fritz' (1864); 'Histoire d'un Conscrit de 1813' (1864); 'Waterloo' (1865); 'Le Blocus' (1867); 'Histoire d'un Paysan' (1868); and 'Contes Populaires.' They also published three plays — 'Le Juif Polonais' (known in its English adaptation as 'The Bells'), a dramatized version of 'L'Ami Fritz' and 'Les Rantzau.' When the two friends met they elaborated the scheme of a work; then Erckmann wrote it. Chatrian corrected it, and sometimes put it in the fire. Erckmann would even be required by his friend to write his story over three times. Latterly the two friends disagreed, and the world received no more of their minute transcripts from the daily life of the Alsatian peasant.

Erdmann, Johann Eduard, yō'hän ĕd'ooärd ĕrd'män, German philosopher: b. Wolmar, in Livonia, 13 June 1805; d. Halle 12 June 1892. In 1829 he became a clergyman in his native town, and in 1836 professor extraordinary of philosophy at the University of Halle, being appointed ordinary professor in 1839. He wrote numerous philosophical works, characterized for the most part by their Hegelian tendencies. Of these some of the chief are: 'Body and Soul'; 'Nature and Creation'; 'Outlines of Psychology'; 'Outlines of Logic and Metaphysics'; 'Psychological Letters'; 'Belief and Knowledge,' etc. His greatest work, however, is his 'Outlines of the History of Philosophy,' of which an English translation appeared in 1889.

Erdmann, Otto Linné, ŏt'tō lin-nā', German chemist: b. Dresden 11 April 1804; d. Leipsic 9 Oct. 1869. His researches embrace a wide range of subjects. He examined minutely the technology of nickel, and described some of its compounds; analyzed a number of minerals and slags, and experimented on several other points of inorganic chemistry. In organic chemistry his chief research is upon indigo, in the course of which he discovered isatin. The most important work in which he engaged was that upon the combining weights of several of the elements. In company with Marchand he made determinations of oxygen, carbon, hydrogen, sulphur, calcium, copper, mercury, and some others, and his numbers have been fully confirmed by subsequent experimenters. He was the author of a chemical text-book and for many years conducted the 'Journal für technische und ökonomische Chemie,' which was afterward changed to the 'Journal für praktische Chemie.'

Erdmannsdörfer, ĕrd'mänz-dėrf-ĕr, **Bernhard,** German historian: b. Altenburg 24 Jan. 1833; d. 1901. He held professorships of history at several German universities, and among his more important works are: 'Das Zeitalter der Novelle in Hellas' (1870); 'Deutsche Geschichte vom Westfälischen Frieden bis zur Regierungszeit Friedrichs des Grossen' (1890–4).

Erdmannsdörfer, Max, German musician: b. Nuremberg 1848. He conducted the court orchestra at Sondershausen 1871–80, becoming director of the Imperial Musical Society at Moscow 1882 and professor in the conservatory in that city. He was leader of the Philharmonic Society at Bremen 1889–95, and became leader of the court orchestra at Munich 1896. His chief works are: 'Prinzessin Ilse' (1870); 'Schneewittchen' (1873); and 'Traumkönig and sein Lieb.'

Er'ebus, in Greek mythology, the son of Chaos and Darkness. He married his sister, Night, and was the father of the Light and Day. The Moirai, or Fates, by some are called his daughters. He was transformed into a river, and plunged into Tartarus, because he aided the Titans. From him the name Erebus was given to the infernal regions, particularly that part of it designated as the abode of virtuous shades, whence they pass over immediately to the Elysian fields.

Erebus, Mount, an active volcano on Victoria Land, in lat. 78° 10' S., rising 12,367 feet above the sea. It was discovered in 1841 by Ross, who named it after one of his vessels. His progress further south was barred by a wall of ice.

Erechtheum, ē-rek-thē'ŭm, the temple of Erechtheus (q.v.) on the Acropolis at Athens. It was built in honor of Athene, Poseidon, and Zeus. The name of Erechtheus is associated, as a local hero or demigod, with that of Athene. In this temple was preserved the oldest existing statue of Athene, which was fabled to have fallen from heaven, and the sacred olive-tree created by Athene as a gift to the city, of which she is worshipped as Athene Polias, the protector of the town and state. The building is one of the finest remaining examples of Greek architecture, having been rebuilt during the Peloponnesian war in pure Ionic style. Its ground plan is unusual, resulting from the union under one roof of three separate chapels, or halls of worship. The porch of the caryatides is one of its distinguishing features. In this porch the place of columns is taken by colossal figures of women whose heads support the capitals on which the entablature rests.

Erechtheus, ē-rĕk'thūs, Attic hero or demigod, worshipped in the earliest period of Athenian history. He was brought up by Athene, who placed him while yet a babe in a chest, which was entrusted to Agraulos, Pandrosos, and Herse, the daughters of Cecrops, with the strict charge that it was not to be opened. Unable to restrain their curiosity, they opened the chest, and discovering a child entwined with serpents, were punished with frenzy, and threw themselves down the most precipitous part of the Acropolis. Afterward Erechtheus was the chief means of establishing the worship of Athene in Attica, where he instituted the Panathenæa in her honor. See ERECHTHEUM.

Eremacausis, ĕr'ē-mạ-kâ'rĭs, slow combustion (from Greek *ĕrĕma,* gently, and *kausis,* burning), a term employed by Liebig to denote the gradual combination of the constituents of a combustible substance with the oxygen of the air.

Eremites (ĕr'ẹ-mīts) **of St. Francis,** and **Eremites of St. Jerome,** two religious orders of the Roman Catholic Church. The order of the Eremites of St. Francis de Paula was founded by Francis, a native of Paula, in Calabria, 1436, and had there its first house. It received the approval of the Holy See 1474; it is properly styled Order of Minim Hermits of St. Francis de Paula (Ordo Minimorum Eremitarum Sancti Francisci de Paula). Their founder chose the name "Minims" (*minimi,* least, littlest) to keep the brethren ever in mind of the Christian humility to which they were vowed. The order of Eremites of St. Jerome, styled also Hieronymites, consisted originally of hermits, but they adopted the cenobite rule of St. Austin with the approval of Gregory XI., 1373. This order was confined to the Spanish peninsula.

Ere'tria, Greece, an ancient Ionic trading and colonizing town on the southwest coast of Eubœa, which was destroyed by the Persians in 490 B.C., and rebuilt by the Athenians. The recent excavations and explorations made by the American school at Athens and the Greek Archæological Society, have resulted in finding an old temple and many other buildings.

Erfurt, ĕr'foort, Germany, (1) town, in the Prussian province of Saxony, formerly the capital of Thuringia, and a fortress till 1873), situated on the river Gera, about 13 miles west of Weimar. In the 15th and 16th centuries Erfurt was a flourishing commercial and manufacturing place, but its university made it one of the most famous of German cities. The university, established in 1378, was suppressed in 1816. Its trade and manufactures have rapidly increased in recent times along with its population. The most characteristic industry is that of flower-growing, plants and seed being exported in enormous quantities to almost all parts of the world. The most important edifice is the cathedral. The large bell called *Maria gloriosa,* made of the finest bell-metal, and weighing 275 hundredweights, hangs in one of the towers. The cell in which Luther lived while an Augustinian monk, from 1505 to 1512, containing his Bible, portrait, etc., was in the Martinsstift or orphan-house into which the old Augustinian convent had been converted, but was destroyed by fire, along with the relics of Luther, in 1872. According to tradition Erfurt was founded as early as the 5th century, by a certain Erpes. It was not a free imperial city, but always maintained a sort of independence. Saint Boniface established here an episcopal see. In 1483 it concluded a treaty with Saxony, by which it agreed to pay an annual sum for protection. In the 17th century the Elector of Mainz obtained possession of it. The Congress of Erfurt (September–October 1808) was attended by Napoleon, Alexander of Russia, and many German sovereigns. In 1813 the town was taken by the Prussians, after a severe bombardment. In 1814 it was granted to Prussia by the Congress of Vienna. Pop. 73,581. (2) The government of Erfurt of which it is the capital has an area of 1,263 square miles. Pop. 434,180.

Erg (Gr. «work»), in physics, the unit of work in the C. G. S. system. It is the work done in overcoming a force of one dyne, through a distance of one centimetre. See UNITS.

Er'gograph, The, a machine for testing a child's capacity for study, and which shows the degree of fatigue that is experienced by pupils. Its operation is based on the fact that the fatigue of a set of muscles, if accurately measured, will show the extent of the general weariness. The physical deterioration of many school children has been a source of anxiety to both physicians and instructors; if by means of this instrument the exact power of endurance of each pupil can be demonstrated, the course of study can be so arranged as to suit different temperaments and so lessen the mental strain. Also a machine for registering the exact effort made in any feat of strength, testing the comparative and relative strength of various sets of muscles.

Ergot, ėr'gŏt, according to the United States Pharmacopœia, «is the sclerotium of the fungus *Claviceps purpurea* replacing the seed of the rye.» Thus the Pharmacopœia calls for a certain definite kind of ergot for medicinal use; but there are a number of allied species of parasitic fungi that infest not only the rye, but a number of other grasses; other species of the same genus (*Claviceps*), and other genera. Both the botanical and physiological relationships of these forms are close. The ordinary ergot of commerce consists of purplish grain-like masses, one half to three quarters of an inch long and one eighth to one quarter of an inch wide, and somewhat resembling large grains of rye. Microscopically the ergot is made up of the closely matted mycelium of the fungus, which has entirely replaced the cells of the seed.

The fungus is propagated by means of minute spores. These are blown about by the wind, or carried about by insects, and lodge upon rye or other grasses. They there germinate and form a more or less viscid yellowish mass filled with spores of another type, the conidia. These in turn may be carried by insects to other grasses. As the fungus grows and, little by little, replaces the tissue in the grain, there results a brownish to blackish mass which in different species assumes different shapes. These are collected with the different grasses and may be the cause of various types of poisoning in cattle. The fungus growing on rye constitutes the ergot of commerce, which has been used in medicine for many years. The principal sources of ergot at the present time are Spain and Russia.

Chemically considered, ergot is an extremely complex body, and it cannot be said that even at the present time a full knowledge of its composition has been gained. It contains large quantities of an inert fixed oil, a resin, and one or two active principles which, from the earliest chemical investigation to the present, have been called by no less than 50 or 60 different names, among these being ergotine, ecboline, ergotin, cornutine, sphacelic acid, ergotic acid, etc. The unsatisfactory condition of organic drug analysis accounts for these varying results and confusions. The investigations of Kobert (1890) and his students are the first of real merit, and Kobert isolated a body cornutine to which he ascribed the chief activity of ergot. More recently, however, Jacobi, a student of Schmiedeberg, has isolated two bodies, sphacelotoxin and chrystoxin which are, he claims, the active principles.

Taken internally, ergot has the singular power of stimulating an involuntary muscle, causing it to contract. In this manner it produces a number of reactions on those organs which are rich in this type of muscular fibre. Acting on the heart and blood vessels, it contracts the cardiac muscle and the arterial walls, causing an increase in the force of the heart's contraction and a marked rise in the blood-pressure. It also stimulates the unstriped muscular tissue of the stomach and intestines, occasionally causing purging with violent peristalsis. The organ in the body containing the greatest amount of unstriped muscular tissue is the uterus, and naturally the action of ergot would be most forcibly manifested in this organ. It here causes contractions, the uterus becoming hard and pale, and forces the blood out of the uterine blood vessels. During pregnancy the action is much more pronounced, since the uterus is so much more dilated. Ergot has many applications in medicine, but its chief uses are to control blood pressure and to treat uterine disorders.

Er'gotism. In the article on ergot it has been shown that there are a great many closely related parasitic fungi, growing on different varieties of grasses. A number of these infected grasses, belonging to the ergot family produce, when eaten by cattle, forms of acute and chronic poisoning. These are characterized by changes, particularly in the blood vessels, causing swellings below the knees or ankles, with gangrene of the skin, and at times symptoms of paralysis of the extremities. In years in which unusual humid conditions have permitted the wide and abundant growth of these parasitic fungi, large areas of pasture land have become infected, resulting in widespread poisoning of cattle, almost resembling epidemics.

In Europe, where the eating of rye bread is much more common than in this country, particularly in Russia and Italy, cases of chronic poisoning by ergot occur in man from eating the bread made from infected grain. The chief symptoms here are those referable to changes in the blood vessels of different parts of the body, with secondary consequences. Thus, in some, there is a loss of touch-sensations in the hands and feet, a condition which may go on to the formation of ulcers and gangrene. This is the result of the cutting off of the blood supply to the periphery of the body by the contracting influence of the poison on the walls of the blood vessels. In some cases disease of the spinal cord results. This is thought to be due to the artificially induced anæmia with secondary degenerations in the columns of the cord. This disease, called pellagra, closely resembles a toxic neuritis, or locomotor ataxia. See Ergot; Pellagra.

Eric, ē'rĭk or ā'rĭk, the name of several Danish and Swedish kings. Eric VII., king of Denmark, b. 1382; d. Rügenwald 1459; the son of Duke Wratislaw of Pomerania, was selected as her successor by Queen Margaret of Denmark, and in 1412 mounted the throne of Denmark, Norway, and Sweden, united by the treaty of Calmar. Cruel and cowardly in character, he lost Sweden in 1437 through a revolt of the peasants of Dalecarlia, and in 1439 was deposed also in Denmark. Eric VIII., “The Saint,” became king of Sweden in 1155, did much to extend Christianity in his dominions, and to improve the laws, and fell in battle with the Danes in 1160. Eric XIV., the last of the name who reigned in Sweden, succeeded in 1560 to the throne of his father, the great Gustavus Vasa, and at once began to exhibit the folly that disgraced his reign. He married a Swedish peasant girl, who acquired an influence over him which was ascribed by the superstitious to witchcraft; she alone was able to control him in the violent paroxysms of blind fury to which he was subject. His capricious cruelties and the disastrous wars that followed on his follies at length alienated his subjects, who threw off their allegiance in 1568 and elected his brother John to the throne. In 1577 he ended his miserable life half voluntarily by a cup of poison. He had a genuine love of letters, and solaced his captivity with music and the composition of psalms. His story has been worked into dramatic form by Swedish poets; in German by Kruse in his tragedy, ‘King Erich’ (1871).

Eric the Red, the colonizer of Greenland: b. Norway about 950. After committing homicide he fled to Iceland and in 984, again seeking asylum as a murderer, he reached Greenland. Here he built a chief town, called Gardar, which he settled with Norwegians. His son, Leif Ericson, introduced Christianity, but after flourishing for about four centuries the colony was wiped out, probably by some such plague as black death, although recent authorities attribute its disappearance to famine.

Ericaceæ, ĕr-ĭ-kā'sē-ē, **the heaths,** a family of shrubs or under-shrubs with small leaves, evergreen in some of the genera, rigid, whorled, or opposite, and without stipules. The flowers are arranged in various styles of inflorescence, and are generally very beautiful, the heath probably excelling all other families in the universal beauty of its blossoms. Different writers number the genera from 40 to 70, and the species from 1,000 to upward of 1,300. They are of very wide distribution, the greater number being natives of South Africa. In the North American flora, at least 20 genera are represented, among them such plants as the azaleas, rhododendrons, kalmias, trailing arbutus, and the heaths.

Er'ichsen, Sir John Eric, English surgeon: b. Copenhagen, Denmark, 19 July 1818; d. Folkestone, England, 23 Sept. 1896. He became a member of the Royal College of Surgeons in 1839, and in 1850 professor of surgery at University College. In 1865 he succeeded Quain as professor of clinical surgery in the same college, a post which he held till his retirement in 1875. He was appointed president of University College in 1887, and held that post till his death. His most important work was his ‘Science and Art of Surgery’ (1853), which has gone through many editions, and has been translated into several languages. He also published a volume on ‘Concussion of the Spine’ (1875).

Ericht, ĕr'iᴋt, **Loch,** a lake in the Grampian Mountains, in Scotland, on the boundary between the counties of Perth and Inverness; it is 60 miles northwest of Perth. It is 14⅜ miles long, from ¼ to 1⅛ miles wide, and 1,153 feet above sea-level. It has two outlets, one flows into Loch Lydoch and one into Loch Rannoch.

Erichthonius, in Greek mythology, the son of Dardanus and Bateia, and grandson of Zeus. He obtained the kingdom of Troy by the death of his brother Ilus without children. He married Astyoche, the daughter of Simos, by whom (or according to some by Callirrhoë, the daughter of Scamander) he became the father of Tros. The myth or tradition of Erichthonius is sometimes blent or confused with that of Erectheus.

Ericson, Leif, lĭf ĕr'ik-sŏn, Icelandic discoverer. According to Sagas he was the son of Eric the Red (q.v.) and at the beginning of the 11th century discovered a transatlantic country, which he called Vinland, from the vines which abounded there. Here an Icelandic settlement was established, but whether the coast was Labrador, Newfoundland or some region farther south has not been decided. A much idealized statue of Leif Ericson adorns Commonwealth Avenue, Boston, the work of Miss Anne Whitney, the sculptor.

Er'icsson, John, American inventor: b. Wermland, Sweden, 31 July 1803; d. New York 8 March 1889. He entered the Swedish army in 1820, but resigned in 1827, and soon became known as an inventor. In 1828 he made the first application to navigation of the principle of condensing steam and returning the water to the boiler; later he brought out a self-acting gunlock by means of which naval cannon could be automatically discharged at any elevation without regard to the rolling of the ship. In 1833 he designed a caloric engine; and in 1836 invented the screw propeller, which revolutionized navigation. Ericsson came to the United States in 1839 and two years later built the screw-propelling warship Princeton for the government. This was the pioneer of modern naval construction and the foundation of the steam marine of the world. The achievement, however, which made him most famous in the United States was the construction in 1861 of the ironclad Monitor, which was built under a patent granted by the United States government to Theodore Ruggles Timby (q.v.), the inventor of the revolving turret, etc., was launched 100 days after its keel was laid, and arrived in Hampton Roads just in time to defeat, on 9 March 1862, the Confederate ironclad Merrimac, which had destroyed several wooden warships. But for this signal victory the result of the War would doubtless have been changed and European interference attempted. A fleet of monitors was soon built and did important service during the remainder of the War. His remains were taken to Sweden on the cruiser Baltimore, and interred with imposing ceremonies. The centenary of his birth, 31 July 1903, was observed in New York by the unveiling of a bronze statue of the inventor in Battery Park and in Worcester, Mass., which has a Swedish population of 2,000, by public orations and eulogies.

Ericsson, Nils, Swedish engineer: b. Stockholm 31 Jan. 1802; d. there 8 Sept. 1870. He was a brother of John Ericsson (q.v.). He received the appointment as colonel of the Naval Engineering Corps 1850, becoming director of government railroad construction 1858. Among his engineering achievements were the construction of the Stockholm docks, the canal between Lake Saima and the Gulf of Finland and the Trollhättan Canal sluices.

Eridanus, ẹ-rĭd'ạ-nŭs, a river famous in mythology, mentioned in the return of the Argonauts. It is located in northern Europe and by some said to mean the Rhône, but generally thought to refer to the Po, in Italy. When Phæthon was struck by the thunderbolts of Zeus he fell into this river — and his three sisters, the Heliades, lamented him until they were changed into poplars. They did not cease to weep for him even in this condition; and their tears falling into the water of the river, became transparent amber.

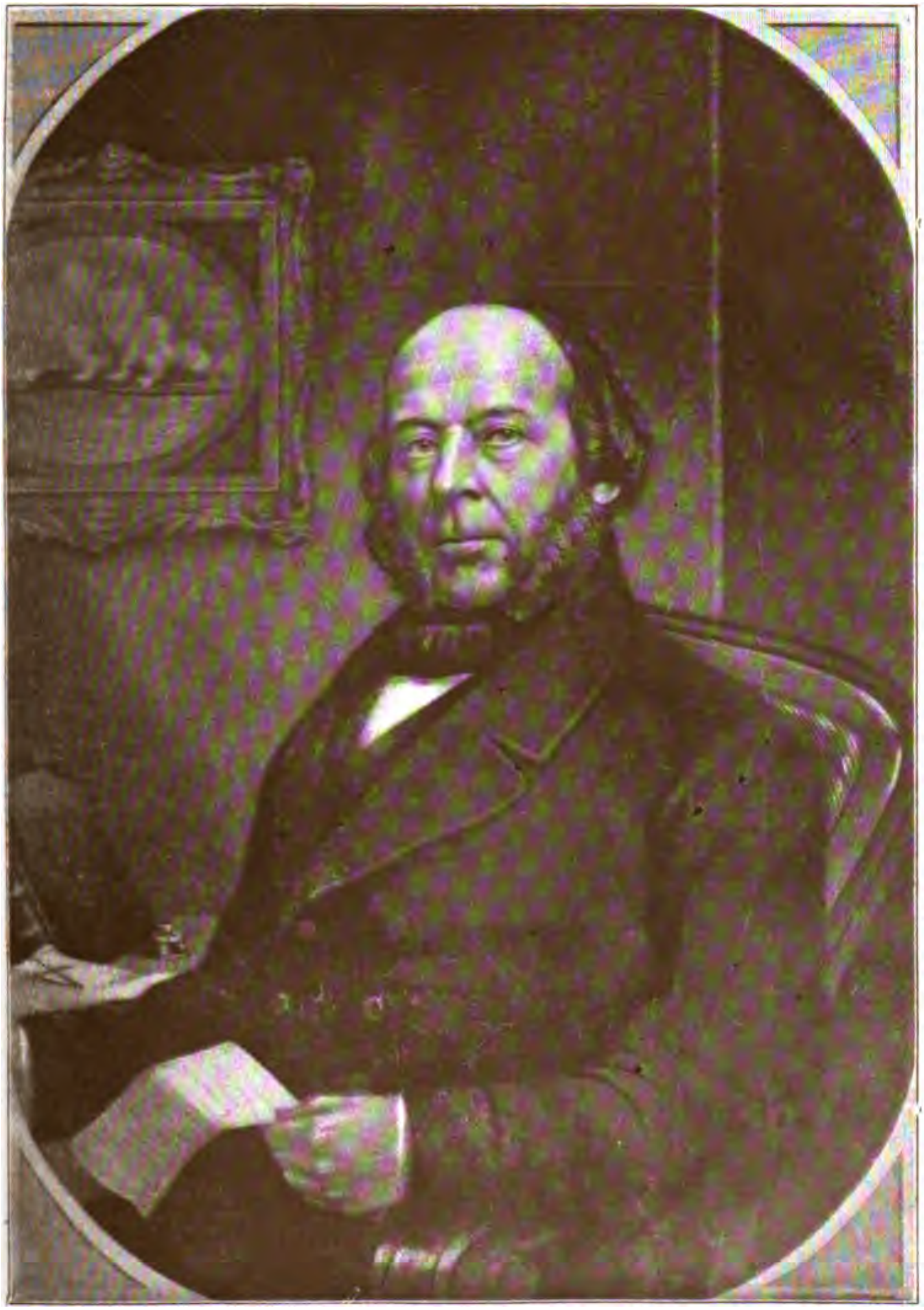
Erie, Kan., city, county-seat of Neosho County; 115 miles east by south of Wichita; on the Atchison, T. & S. F. and the M. K. & T. R.R.'s. It is surrounded by a good farming country; and contains flour-mills, grain elevators, and lumber yards. There are oil and natural gas fields nearby. Pop. (1910) 1,300.

Erie, Pa., city, port of entry, county-seat of Erie County, on Lake Erie, and on the Lake Shore, the Pennsylvania, the Erie, and several other railroads; 85 miles southwest of Buffalo; 100 miles northeast of Cleveland. Erie is on a bluff having a grand view of the lake, is laid out with broad streets at right angles with each other, and has several large and attractive parks. It is lighted with gas and electricity, and has a bountiful supply of water from the lake. The peculiarly advantageous location of Erie has given it high rank as a shipping and manufacturing point. It has the largest land-locked harbor on Lake Erie. The harbor has been greatly improved, and is now 5 miles long by 1 mile wide, depth 9 to 25 feet. Presque Isle, lying directly in front of the city, furnishes means of ample protection; three lighthouses stand at the entrance to the harbor, and substantial wharves, where merchandise is transferred directly from vessels to cars, extend along the entire front. The principal industries are manufactures of iron, steam engines, machinery, car-wheels, car-work, and stoves; flour and grist mill products, brick, leather, organ, pump, furniture, and various kinds of woodwork factories, petroleum refineries, breweries, and malt-houses. The leading articles of shipment are lumber, bituminous and semi-bituminous coal, iron ore, petroleum, and manufacturing products, and these are conveyed by railroads, steamboats, and sailing vessels that ply regularly between Erie and other ports on the Great Lakes. Among the notable buildings are the City Hall, Union Depot, Government Building (including Post-office, Custom House, and other departments), State Soldiers' and Sailors' Home on Garrison Hill, Hamot Hospital, St. Vincent Hospital, Protestant Home for the Friendless, United States Marine Hospital, and Central School. Near the city is a memorial in the form of a blockhouse, erected by the State, in honor of Anthony Wayne. The city has excellent public and private schools, a public library, daily and weekly newspapers, three national and several savings banks. Erie occupies the site of a French fort, called Fort de la Presque, built in 1749; was laid out as a town in 1795; had a portion incorporated as a borough in 1805; and the whole was given a city charter in 1851. It was the headquarters of Commodore Perry in the War of 1812; the fleet with which he defeated the British in the battle of Put-in-Bay (10 Sept. 1813) was built and equipped here. Natural gas was discovered in 1889. Pop. (1910) 66,525.

Erie Canal. See CANALS.

Erie, Fort. See FORT ERIE.

Erie, Lake, one of the Great Lakes of North America; situated between lat. 41° 30' and 42° 52' N., and lon. 78° 53' and 83° 25' W. It lies between Lakes Huron and Ontario and is bordered on the north by Canada, on the east and south by New York, Pennsylvania, and Ohio, on the west by Ohio and Michigan. Its greatest extent is northeast and southwest; it is about 245 miles long, 50 miles wide (from 28 to 58), and has an area of about 9,900 square miles; is 573 feet above sea-level, 8 feet below Lake Huron; has a maximum of 210 feet, and an average depth of 100 feet. It receives, through the strait, Detroit River, the waters from all the other Great Lakes except Ontario; and the chief streams exclusive of the waters from the Great Lakes which flow into it are the Grand, from the north, the Maumee, Sandusky, Huron, Grand, and Cuyahoga from the south. Its outlet is Niagara River which flows into Lake Ontario. Some of the indentations are the bays of Sandusky and Maumee, on the south coast, and Long Point Bay on the north. In the western part is a group of islands, some of which are Point Pelee, Kelly's, North, Middle, and South Bass. Lake Erie is the shallowest of all the Great Lakes, and dangers to navigation are increased by the heavy ground-swell. In 1870 the Weather Bureau of the United States established a number of stations on the Great



JOHN ERICSSON.

INVENTOR OF THE MONITOR.

Lakes, and since have made accurate observations and reports on the rainfall, the changes taking place, and other matters connected with these lakes. In 1872 the water in Lake Erie was below normal, and the rainfall was below normal at every station on the Great Lakes (Ontario stations not considered in these statements). In 1876 the water in Lake Erie was higher than usual, the rainfall at all stations above normal except Marquette, where it was nearly an inch below. In 1878 the Lake was again high; the rainfall also above normal except at Duluth and Grand Haven, where it was below normal. In 1882 the Lake was again above normal, and at 10 stations the rainfall was above normal, but at Milwaukee, Detroit, and Buffalo it was below normal. In 1902 the rainfall at all stations was heavy and Lake Erie was above normal. The effect rainfall has on the level of Lake Erie has been shown from the observations made since 1870. The destruction of lakes is largely due to filling from deposits brought by inlets or tributaries; every particle of sediment brought into a lake tends toward its destruction. Another danger is in changes in outlets. Where the Niagara River emerges from Lake Erie there has been but little change for centuries. It flows through a plain, and the channel is to-day, apparently, what it was hundreds of years ago; but "Niagara is wearing back its falls toward Lake Erie; and in given time, as a result of this work, it will so lower the outlet as to completely drain Lake Erie." The importance of Lake Erie for commercial purpose has been greatly enhanced by its canal connections. The Welland Canal around Niagara Falls removes obstacles to direct navigation from the Atlantic; the Erie Canal connects the Lake by a short route, with the Hudson River; canals crossing Ohio connect the Lake with the Ohio River. There are many excellent harbors, not all of them in use by the large steamship lines. Some of the principal ports are Buffalo, Erie, Cleveland, Sandusky, and Toledo. At Put-in-Bay, near Sandusky on 10 Sept. 1813, took place the Battle of Lake Erie (q.v.) The Americans were successful, and the result was most important to the United States; it had much to do with the regaining of the territory of Michigan, which at the time was in possession of the British. Consult: Russell, ‘Lakes of North America’; Smithsonian An. Report, ‘Modification of Great Lakes by Earth Movement’ (1898).

Erie, Lake, Battle of, 10 Sept. 1813: a naval battle which annihilated the British fleet on that lake, and gave the Americans their northwest at the Treaty of Ghent. In 1813 it had become evident that the reconquest of the northwest from the British, who had captured Detroit and were building a fleet at Malden, near by to control the Lake, depended on wresting the control from them; and Oliver Hazard Perry spent from 27 March till September building a rival fleet at Presque Isle, now Erie, Pa. It had nine vessels: the Lawrence, flagship, 20 guns; the Niagara, Capt. J. D. Elliott, 20 guns; the Caledonia, three-gun brig; five two-gun schooners and a one-gun sloop; in all 54 guns with 714 pounds metal at a broadside. The British had six vessels averaging much heavier, with 63 guns averaging much lighter — about 430 pounds to a broadside; but most of them were far longer range than the American, whose policy therefore was close action. The crews were about equal, some 500 each. The British commandant was Capt. Robert H. Barclay, a veteran of Nelson's; two of the captains were veterans also. The fleets engaged off the islands north of Sandusky Bay, near noon of 10 September. Perry in the Lawrence, with two gunboats, came to close quarters shortly after, and if the whole fleet had followed, the British would soon have been overwhelmed; but for some reason (hotly disputed and a sore point for many years) the other vessels kept off and played away at long range, while for two hours the British vessels concentrated their fire on the Lawrence. Such carnage was scarcely ever known on the ocean; of 103 officers and men, but 20 were unhurt; the vessel was literally shot to pieces, and the very wounded were killed on the surgeon's board by the crashing balls. Seeing that no more could be done with it, Perry turned over the command to a lieutenant, transferred himself in a small boat to the Niagara, now tardily drawn nearer, brought that and the rest into close action, and in 15 minutes (about 3 P.M.) forced the entire British fleet to surrender. The latter was in a dreadful condition, too; the English had fought with heroism and skill, but a third of its force was disabled or dead. The losses were: Americans, 27 killed, and 96 wounded; British, 41 killed and 94 wounded. The battle raised Perry to the summit of naval fame, justly, for no victory was ever more due to the genius and energy of one man, and few naval battles have had such momentous results. The remains of the slain officers were buried at Put-in-Bay Island in 1858. Maclay's ‘History of the Navy’ (Vol II. 1894); Spears' ‘History of Our Navy’ (1899); Roosevelt's ‘History of the Naval War of 1812’ (1882); Henry Adams, ‘History of the United States’ (Vol. VII. 1891).

Erie Railroad. Chartered 24 April 1832, by the New York State Legislature to construct a railroad from Lake Erie to the Hudson river, the New York & Lake Erie Railway Company was organized with a capital of $3,000,000, the credit of the State being extended to a like amount. The charter provided that the road should make no connection with any railroad in New Jersey or Pennsylvania without special legislative consent and also provided that it should run through the southern tier counties of New York. This plan was in accordance with the idea advanced by W. C. Redfield in 1830 when he proposed a railroad from the Atlantic to the Mississippi river. His plan was that it should be a great national road to follow the so-called "Appian Way" advocated by Generals Clinton and Sullivan in 1780 to further the development of what then constituted the United States.

In 1841, the railroad was opened from Piermont, at the extreme southern point of New York State on the Hudson river, inland to Goshen, Orange County, a distance of 46 miles. Opposed at it was by the canal counties and their representatives in both the State and National Legislatures, the Erie had to fight for its existence from its birth through a series of legislative obstructions and financial manipulations that developed even in its early days. Before its completion to Dunkirk, which was the objective point on Lake Erie, and as a consequence of these obstacles to progress, the road had to be placed in the hands of a receiver. In 1845, the State released its claim for the money advanced for construction and through the energetic efforts of the Erie's friends, it was finally opened by President Fillmore, Daniel Webster, his Secretary of State, and other government and state officials, from Piermont to Dunkirk, on 22 April 1851, a distance of 463 miles. From Piermont, passengers were conveyed to New York by steamer. This operated so much to the disadvantage of the road that its charter was amended in 1852 permitting it to pass through New Jersey to its present terminal in Jersey City, and Piermont was abandoned as a terminal in May, 1861. Previous to that abandonment, the road was again — in 1859 — in the hands of a receiver and was sold to the Erie Railway Company in 1861. This new company also bought the Buffalo and New York City Railroad and so secured independent entrance into Buffalo, which was made its principal lake terminal in place of Dunkirk. It has so remained up to this time. The company also took over the Union Steamboat Company, operating on Lake Erie, in the same year and so added Cleveland and Detroit to its lake terminals.

In accordance with English ideas, the road was built with a six foot gauge, a mistake in construction that for years acted as a deterrent to its successful operation, owing to the fact that contents of cars had to be transferred at connecting points. Another mistake of its early managers was a refusal of the Erie to accept entrance into New York City over the New York & Harlem lines, then being constructed and which later passed to the control of the New York Central. But this management did see the value of the coal traffic and in 1861, it entered the anthracite coal fields of Pennsylvania and later through its Bradford branch, reached the bituminous fields. But in the meantime, it had become a financial foot-ball in Wall street, partly through a desire to combine with the Atlantic & Great Western, then building through Ohio, for the purpose of making a route to St. Louis on the Mississippi river. A connection to the Ohio river at Cincinnati was ultimately effected through a combination with the Atlantic & Great Western and an operating connection with the C., H. & D. completed 33 years after the first work on the Erie was begun.

In 1867, Jay Gould and Colonel James Fisk came into possession of the Erie and from 1868 to 1872 a fight ensued between Gould, Vanderbilt, Fisk, James McHenry, and Daniel Drew for the possession of the property, resulting in its spectacular wreckage after one of the bitterest and most vindictive railway wars in history. The contest for the possession of the property and the financial manipulations indulged in enriched all who were interested excepting the actual owners of the road and these it impoverished as it did the road itself. At the conclusion of this historic fight, Hugh J. Jewett came in as president in 1874 and a year later was made receiver, the property having been purchased by the security holders to prevent its complete wreckage. It was reorganized in 1878 as the New York, Lake Erie & Western. It then owned 525 miles of road and leased 400 more. The road was converted into a standard gauge road at a cost of $25,000,000 and was double tracked from Jersey City to Buffalo.

Attempts to enter Chicago, first over what is now known as the "Panhandle Route," and later over the Pittsburg, Fort Wayne & Chicago were successfully blocked by rivals and it was not until 1883 that it secured an entrance into the western metropolis over the Chicago & Atlantic Railway. Under succeeding managements, the road, in spite of the enormous financial obligations which hampered it, was operated as a paying and successful property until the panic of 1883–4. The obligations accruing because of its purchase of the Chicago & Atlantic and Pennsylvania coal properties led the road to still further embarrassment and finally to another receivership in 1893. Two years later, the company was reorganized as the Erie Railroad Company and assumed possession of the property on 1 Dec. 1895, which it has since operated.

The history of the Erie Railroad is briefly the history of railroading in the United States. The total mileage of the Erie is 2,147, made up as follows: *Erie Division*: New York Div., 197 miles; Delaware Div., 128 miles; Susquehanna Div., 140 miles; Jefferson Div., 43 miles; Tioga Div., 65 miles; Rochester Div., 146 miles; Buffalo Div., 203 miles; Alleghany Div., 131 miles; Bradford Div., 83 miles; Wyoming Div., 59 miles. *Ohio Division*: Meadville Div., 225 miles; Cincinnati Div., 197 miles; Mahoning Div., 164 miles; Lima Div., 127 miles; Chicago Div., 123 miles; Greenwood Lake Div., 52 miles; Northern R. R. of New Jersey, 26 miles; New Jersey & N. Y. R. R., 38 miles.

For the year ending 30 June 1905, the total earnings were $45,724,737, other income $1,048,689, operating expenses $33,142,208, leaving a total net income of $13,631,218.

A pioneer as a trunk line, it was also the first railroad to adopt what are now universal methods — among these, the running of trains by telegraph, the use of a printed time table, the running of Sunday trains, emigrant trains, and special service for suburban passengers, the use of parlor cars, the establishment of dining rooms along the line, the establishment of special milk trains, the running of a newspaper special train (this being done in 1842). It was also the first road to run an excursion train of the modern type with a brass band and a reduced round trip fare, the first road to use a bell cord to signal from the conductor to the engineer, the first to build up local industries by furnishing to manufacturing companies the use of switching and terminal tracks, a custom now so universal, and in more modern days, the first road to adopt all-steel baggage, express, and mail cars.

J. H. MADDY,
Special Representative.

Erigena, ĕ-rĭj'ĕ-na, **Johannes**. See SCOTUS, JOHANNES ERIGENA.

E'rin, an old name for Ireland. Now used only in poetry.

Erinite, a basic copper arsenate having the formula $Cu_5(OH)_4As_2O_8$, occurring as a dark green crystalline coating of fibrous structure in Cornwall, England, and the Tintic district, Utah. The name is also applied to an aluminum silicate from the Giant's Causeway, Ireland.

Erinna, ē-rĭn'ạ, Greek poetess: b. Rhodes or Teos, about 600 B.C.; d. at age of 19. According to some she was a Lesbian, and the intimate friend of Sappho. Others aver that she was born at Teos, Rhodes, or Telos, and that she lived in the age of Demosthenes; while others again assert that there were two poetesses of the same name. She left behind her a few poems which were thought equal to those of Homer in point of merit. The chief of them was a work of about 300 lines, called 'Elakatē' (The Distaff), of which nothing has come down to us.

Erinyes, ē-rĭn'ĭ-ēz. The Furies (q.v.).

Eriocaulon, ĕr-ĭ-ō-kâ'lŏn, the typical genus of the pipewort family (*Eriocaulonaceæ*). See PIPEWORT.

Eriodendron, ĕr-ĭ-ō-dĕn'drŏn, a genus of tropical trees of the natural order *Malvaceæ*. There are about a dozen species, which are characterized by digitate leaves, medium to large, white or reddish, solitary or clustered flowers, and thick, woody seed-capsules containing a cotton-like fibre which suggested the name silk cotton-tree. Some of the species exceed 100 feet in height, and furnish wood used in making boats. The seeds of several species are used for food to some extent. But the principal economic value for which these trees are noted is in the fibre which surrounds the seeds. This is too short to be successfully woven like cotton, but is highly valued in upholstery for stuffing cushions, lounges, etc., for making floss and, it is said, as a substitute for animal hair in making felt for hats. The chief source of supply is Java. It is known in various countries as kapok, rimi, bentang, etc. Various South American species of *Bombax*, a related genus, also furnish a similar fibre. Like many other species of the natural order *Malvaceæ*, the species of these two genera also furnish a valuable bast fibre which is used for rope and cordage-making. One species, *E. occidentale*, is grown in California to a small extent as an ornamental tree under the name *Ceiba occidentalis*.

Eriom'eter, an optical instrument for measuring the diameters of minute particles and fibres from the size of the colored rings produced by the diffraction of the light in which the objects are viewed.

Eriphyle, ĕr-ĭ-fī'lē, in the Greek mythology, the daughter of Talaus, and wife of Amphiaraus, whom she betrayed for a necklace presented to her by Polynices. The necklace was made by Hephæstus (Vulcan), and had the power of rendering whoever wore it unlucky.

Eris, ē'rĭs or ĕr'ĭs, in Greek mythology the goddess of discord, daughter of Night, and sister of Nemesis, and the Parcæ or Fates. Not being invited to the marriage of Peleus, she revenged herself by means of the apple of discord. See PARIS.

Erith, England, town in Kent, on the Thames, about 14 miles east of London, contains the Maxim-Nordenfeldt gun-factory, engineering works, and other manufactories. Several yacht clubs have their headquarters here. Pop. 25,868.

Eritrea, ā-rē-trā'ạ, or **Erythræa** (from Greek *erythros*, red, referring to the Red Sea), the official name of an Italian colonial possession stretching along the African shore of the Red Sea from Cape Kasar in lat. 18° 2' N. to the Sultanate of Raheita on Bab-el-Mandeb in lat. 12° 30' N. The coast-line is between 500 and 600 miles in length, and the area of the colony is about 94,800 square miles. The chief town is Massowah. Pop. of the colony about 400,000, the majority of whom are Arabs.

Erivan, ĕr-ĭ-vän', Russia, (1) a fortified town, capital of the government of the same name in Transcaucasia; on the Sanga River, 33 miles northeast from Mount Ararat. The manufactures consist of cottons, earthenware, and leather; and the situation of the town, on the caravan route between Russia and Persia, gives it a considerable transit trade. Pop. 30,275. (2) The government of Erivan has an area of 10,745 square miles, and a pop. of 1,128,003.

Erlangen, ĕr'läng ĕn, Bavaria, town on the Regnitz, 12 miles north of Nuremberg. As old as the 10th century, it owes its prosperity to the settlement here of French Huguenots after the revocation of the Edict of Nantes (1685), and to its university. The chief manufactures are articles made from wood, ivory, and horn, and some cotton goods. It has large breweries. Pop. 23,173.

Erlangen, University of, a Lutheran institution founded in 1742 in Baireuth, but the following year moved to Erlangen (q.v.). In 1769 Alexander, the then margrave of Baireuth, gave valuable assistance to the university and the name was changed to its present legal title, "Friedrich-Alexander University." Owing to the changes of government of the country the growth of the institution was retarded until 1880. Since that time the school has increased in attendance and influence. In 1910 the number of pupils enrolled was about 1,400. Consult: MINERVA.

Erlau, ĕr'low, or **Eger**, ā'ger, Hungary, town, capital of the county Heves, on the Eger, 75 miles east-northeast of Budapest. The manufactures consist chiefly of woolen and linen cloth, hats, combs, leather, shoes, and harness. The finest red wines of Hungary are made from grapes grown in the neighborhood. There are two thermal springs, one on each side of the river. Pop. 25,102.

Erl'king (Ger. *Erlkönig*), a mythical personage first introduced into German poetry, through Herder's translation of a Danish ballad, 'The Erlking's Daughter,' and made familiar to all readers by Goethe's ballad, 'Der Erlkönig,' or translations of it. This goblin is represented as exercising a malignant and fatal influence upon men, and especially children, by alluring promises or visions which lead to their destruction. The word is of Danish origin (*Ellerkonge*, or *Elverkonge*, king of the elves).

Erman, ĕr'män, **Adolf**, German Egyptologist: b. Berlin 31 Oct. 1854. He was educated at Leipsic and Berlin, receiving an appointment as associate professor of Egyptology in the University of Berlin 1883, becoming director of the Egyptian department of the Royal Museum 1885 and attaining full professorship in the university in 1892. He has paid special attention to Egyptian grammar and has written many works on Egyptology, among which are: 'Die Pluralbildung des Ägyptischen' (1878); 'Neuägyptische Grammatik' (1880); 'Die Sprache des Papyrus Westcar' (1889); 'Die Märchen des Papyrus Westcar' (1890); 'Altägyptische Grammatik' (1894); 'Gespräche eines Lebensmüden mit seiner Seele' (1896); 'Die Flexion des Ägyptischen Verbums' (1900); 'Zaubersprüche fur Mutter Kind' (1901); 'Ägypten und Ägyptisches Leben im Altertum' (1885), translated into English by Tirard with title of 'Life in Ancient Egypt' (1894).

Ermine, ėr'mĭn, any weasel (q.v.) which turns white in winter, as is the habit of all those living in snowy regions; or its pelt made up as a fur. The animal's coat becomes completely yellowish white, except the tip of the tail, which remains black. When this fur is made up into tippets, coat trimmings or garments, the black tails are attached as ornaments in rows, which gives the regularly spotted effect characteristic of ermine furs, and imitated in heraldry, under the terms "ermine" and "erminois," expressive of furs as a bearing. In mediæval times the use of this kind of fur was restricted to royalty, and later it became a part of the insignia of judges in high courts, perhaps as a symbol of the majesty of the law; whence the expression "the ermine" as a metonym for the judiciary office. Ermine is mainly derived from northern Russia and Siberia, where it is the fur of the stoat (*Putorius erminea*); but a great amount is supplied by northern Canada, from two or three American species of weasels.

Ermine Moth, any of several white moths marked with black spots as in ermine furs. The name is given in America to various bombycids, but was originally applied to a European zygænid (*Ypomoneuta pellida*).

Ermine or **Ermyne Street**, one of the four great roads constructed in England by the Romans. It led from Bishopsgate, London, by way of Durolipons (Godmanchester), Lindum (Lincoln), Danim (Doncaster) to Eburacum (York), whence it continued northward past Hadrian's wall into Scotland. At Lincoln it formed a junction with the Foss Way, leading to the southwest. The Vicinal Way, a branch from London, led through Essex, Suffolk, and Norfolk to Venta Icenorum (Caistor near Norwich) and connected with the main road at Durolipons by a branch from Camulo-dunum (Colchester).

Ern, or **Erne**, a name in poetic rather than common or scientific use for any of the sea-eagles; specifically the European white-tailed eagle of which the American bald-eagle (*Haliæctus leucocephalus*) is a near relative. See EAGLE.

Ernest Maltravers, a novel by Bulwer-Lytton, published 1837. Its sequel is entitled, 'Alice; or The Mysteries' (1838). In the preface to the first-named novel, the author states that he is indebted for the leading idea of the work — that of a moral education or apprenticeship — to Goethe's 'Wilhelm Meister.' The apprenticeship of Ernest Maltravers is, however, less to art than to life. 'Ernest Maltravers' is written in the Byronic strain, and is a fair example of the English romantic and sentimental novel of the thirties.

Ernesti, Johann August, yō'hän ow'goost ĕr-nĕs'tē, German scholar: b. Tennstädt, Thuringia, 4 Aug. 1707; d. Leipsic 11 Sept. 1781. He studied at Wittenberg and Leipsic, and, devoting himself to classical studies, became rector of the Thomas School at Leipsic in 1734, a post which he held till 1759. He became professor of theology in the university in 1759. He prepared editions of Homer, Callimachus, Polybius, Suetonius, and Tacitus, and of Xenophon's 'Memorabilia' and Aristophanes' 'Clouds,' and an excellent edition of Cicero (3d ed. 1776–7), to which he added a valuable 'Key to Cicero,' often reëdited. He was the founder of a true exegesis of Scripture by the laws of grammar and history, independent of dogmatic prepossessions. His 'Latin Speeches' gained him the name of the "German Cicero."

Ernouf, ār-noof, Alfred Auguste, French historical writer and publicist: b. Paris 21 Sept. 1817; d. there 15 Feb. 1889. 'New Studies of the French Revolution' (1852–4); 'The French in Prussia, 1807–8' (1872); and other works by him evince research and impartiality.

Ernst (ĕrnst) **I.** (surnamed "THE PIOUS"), Duke of Saxe-Gotha: b. castle of Altenburg 24 Dec. 1601; d. 1675. He was the son of John, Duke of Weimar, and brother of the famous Bernard of Saxe-Weimar. He fought with distinction as colonel of horse under Gustavus Adolphus, at the battles of Nuremberg, Lützen, and Nördlingen during the Thirty Years' War, and was one of the signatories to the Peace of Prague in 1635. He afterward became famous for the wisdom of his administration, for the reforms that he instituted, and for the progress his principality made during his reign. He was the founder of the Gotha line which became extinct by the death of Frederick IV. in 1824. Consult: Beck's 'Ernst der Fromme' (1865).

Ernst II., Duke of Saxe-Gotha and Altenburg: b. 1745; d. 1804. On succeeding his father in the dukedom he set about to reform the government, and ameliorate the condition of his people. He refused to allow his army to join the forces of his near relative George III., in fighting against the American colonies, although large sums were offered as an inducement. He was a patron of science; instituted for the first time a measurement of an arc of the meridian in Germany, and established an observatory near Gotha. He wrote on astronomy, and among his works are: 'Astronomische Tafeln' (1799).

Ernst II., Augustus Charles John Leopold Alexander Edward, Duke of Saxe-Coburg-Gotha: b. Coburg 1818; d. 1893. He was brother of Prince Albert, consort of Queen Victoria of England, and seems to have resembled him in tastes and character. He was instrumental in winning the battle of Eckeonporde in the war against Denmark, fought on the side of Prussia in the Austro-Prussian and Franco-Prussian wars. He wrote some successful operas.

Ernst August, ow'goost, King of Hanover and Duke of Cumberland: b. 5 Jan. 1771; d. 18 Nov. 1851. He was the 5th son of George III. of England. He took up his abode at Berlin, but returned to England while the discussions on Catholic emancipation were going on, and endeavored by every means in his power to prevent the passing of that measure. On the death of William IV. in 1837 he ascended the throne of Hanover, in consequence of the succession to the sovereignty of that country being limited to male heirs. His arbitrary and tyrannical disposition, which had hitherto shown itself in opposing every step in the way of political reform and progress, was now manifested by his abrogating the constitution which had been granted in 1833. In 1848, however, he was compelled to accede to popular demands, and accord the nation a more liberal form of government. He was succeeded by his son, George V., the last of the Hanoverian kings. The unpopularity of the Duke of Cumberland in Britain was extreme, and the contingency of his succeeding to the throne was regarded as one of the greatest misfortunes that could befall the nation. See Wilkinson 'Reminiscences of King Ernest of Hanover' (1880).

Ernst Ludwig, Grand Duke of Hesse: b. Darmstadt 1868. He succeeded to the throne in 1892.

Ernst, August Frederic, American educator: b. Hanover, Germany, 25 June 1841. He was graduated at the gymnasium, Celle, Hanover, in 1859; studied later at the University of Göttingen, and came to the United States in 1863. He was pastor of Lutheran congregations till 1869, when he became a professor in the Northwestern University. He was chosen president of the university in 1870; and was president of the Joint Lutheran Synod of Wisconsin, Minnesota, and Michigan, in 1892–5–7–9.

Ernst, Harold Clarence, American bacteriologist; b. Cincinnati, Ohio, 31 July 1856. He was graduated at Harvard University in 1876 and at its Medical School in 1880; and became professor of bacteriology there. He has published: 'Infectiousness of Milk' (1896); 'Infection and Immunity' (1898); 'Prophylactic Hygiene'; etc., and numerous articles in scientific medical periodicals.

Ernst, Heinrich Wilhelm, hīn'rĭн vil'hĕlm ĕrnst, Austrian composer and violinist: b. Brünn 1814; d. Nice, France, 8 Oct. 1865. He was educated at the Vienna Conservatory and made his début in Munich 1830, and subsequently met with a warm reception in the principal cities of Germany. A like success attended him all over the continent. His principal compositions are his 'Elegy', and the 'Phantasy from Othello.'

Ernst, Henry, American educator: b. Anspach-Uringen, Germany, 17 May 1842. He was educated in Germany and in the United States; was graduated at Concordia Seminary, St. Louis, Mo., and at the Capital University, Columbus, Ohio. He entered the Lutheran ministry in 1865, and remained actively in it till 1885, when he became president and professor of theology in the Lutheran Theological Seminary, St. Paul, Minn.

Ernst, Oswald Herbert, American military officer: b. near Cincinnati, Ohio, 27 June 1842. He was graduated at the United States Military Academy and was commissioned a brigadier-general of volunteers 1898. He was engineer in charge of western river improvements in 1878–86; had charge of harbor improvements in Texas in 1886–9; and while on the latter service began the great work which resulted in the dredging of the channel at the entrance of Galveston harbor from 12 to 26 feet. In 1893–8 he was superintendent of the United States Military Academy. In the war with Spain he went with Gen. Miles to Porto Rico in July 1898, and, on 9 Aug. led the troops in the action at Coamo. He has published 'Manual of Practical Military Engineering.'

Ernulf, ĕr'nŭlf, or **Arnulf,** English prelate: b. France 1040; d. 15 March 1124. He was appointed prior of Canterbury by Anselm, and was subsequently abbot of Peterborough (1107) and bishop of Rochester (1114). He was equally remarkable for skill in canon law and personal saintliness; and compiled a great collection of documents about his own Church, laws, papal degrees, etc. He is alluded to in Sterne's 'Tristram Shandy.'

Eroica Symphony, The, a famous symphony by Beethoven, first given at Vienna in 1805, under the title of 'Bonaparte.' It was afterward renamed *Sinfonia eroica.* See BEETHOVEN.

Eros, in astronomy, one of the minor planets, discovered photographically by Witt in 1898, at the Urania Observatory, Berlin. The orbits of most of the other known asteroids lie wholly beyond that of Mars; but Eros approaches much nearer to the sun, and at times it may be within 14,000,000 miles of the earth. It is this fact which gives the planetoid its great astronomical interest. The relative dimensions of the solar system are known with high precision, and if any dimension can be accurately measured in miles, all the other dimensions become known at once, in terms of the same unit. It is apparently possible to determine the parallax of Eros (and hence its distance from the earth in miles) with relatively high precision, and a correspondingly accurate determination of the absolute dimensions of the solar system in general will result. As Eros approaches the earth more closely than any other heavenly body except the moon, its parallax is relatively large; and the fact that its diameter is only about 20 miles, so that it appears in the telescope as a mere point of light without a sensible disk, indicates that extremely precise micrometric measures of its position on the heavens may be had. Astronomers are keenly alive to the possibilities offered by this seemingly insignificant little planet, and at every favorable opposition Eros will be studied with exceeding care. It is considered probable that by the end of the century the observations of Eros will have led to a determination of the sun's distance that will not be in error by more than 25,000 miles, the present uncertainty in this distance being probably fully 150,000 miles.

Eros, the Greek equivalent of the Latin Cupid, the god of love. See CUPID.

Ero'sion, or **Denudation,** the process of slow removal in air or water of the products of rock decay whereby the surface features of the earth are obliterated. It includes the destructive work of winds, of streams, of glaciers, and of the ocean. Its various aspects may be considered under three heads, (1) subaërial; (2) marine, and (3) submarine erosion.

1. Under subaërial erosion comes the action of air and water on all land surfaces above sea-level. Changes of temperature crack off flakes from rock-ledges and reduce them to smaller flakes.

Chemical processes, due to moisture and CO_2 in the air, break up the rock-minerals. In a climate with dry seasons the dust may be swept away by the winds (deflation), leaving the larger pebbles. Stony deserts have thus been formed in Arizona and other parts of the world. The dust-charged winds can carve and wear down rock surfaces. Instances are common in the arid regions of the West and in the desert of Sahara.

The erosive action of water begins with the raindrop. If a piece of soft ground with small stones lying about be examined closely after a shower, it will be found that soil has been beaten down and washed away from the areas not protected by stones. This action sometimes takes place on a larger scale in semi-arid climates when rock-decay is slow, and curious pillars of earth or soft rock capped by protecting boulders are formed. Examples may be found in the Garden of the Gods, Colorado. When the raindrops unite to form tiny rivulets the process of river-erosion has begun. In fact, a patch of soft ground on a hillside during a shower shows many of the phenomena of stream-formation, as likewise does even a dust-covered street. The work of surface water is continuous. Some rock-constituents are dissolved and borne away in solution; other particles are carried away in suspension and, by abrasion on rocks below, help the stream carve its channel deeper. When the current slackens some of the waste from the higher lands may be deposited, the coarser materials first. Thus mountains are worn down and plains formed. The higher the mountains, the deeper the valleys can be carved; but even the highest mountains are ultimately deeply dissected, and finally worn down so that the current of the river may not be strong enough to transport the detritus. A country thus worn down is said to have reached a base-level of erosion, and its nearly level surface forms a peneplain. If such a region be uplifted, the streams will start work again vigorously, and a new cycle of erosion will begin. A region reduced to its base-level, if neither elevated nor depressed, can remain unchanged through millions of years.

The amount of waste brought down by some rivers is enormous. Thus the Po in flood carries one part sediment to every 300 parts of water; the Ganges one part sediment to 835 parts of water. These may seen small ratios of sediment, but the total amount of material discharged annually by the Ganges is calculated to be 378,100,000 tons, while the Nile annually brings down 150,000,000 tons. The Mississippi annually brings to the Gulf of Mexico 406,250,000 tons of material in suspension, enough to lower its whole basin one inch in 300 years. It is calculated that the average amount of material removed as sediment annually by streams over the whole land surface is 600 tons per square mile.

Marine erosion includes wave-action; great waves strike heavy blows against projecting headlands, and the surf on rocky beaches charged with boulders and stones is a never-ceasing mill. The undertow of waves sweeps out and rearranges the fine material ground from the rocks; tidal currents, often strong, may bear the waste long distances, or scour channels in soft formations. If a land surface be slowly sinking, the advancing ocean levels the rock ridges and hills. Submarine erosion, the work done by ocean currents, is of little importance, since these currents are seldom strong enough to abrade rocks. The erosive work of ice differs from that of running water in several particulars and is considered (see GLACIER) separately. Consult: Lyell, 'Principles of Geology' (1872); Geikie, 'Handbook of Geology' (1893); Dana, 'Manual of Geology' (1895); Gilbert, 'Geology of the Henry Mountains' (monograph U. S. Geological Survey 1877); Powell, 'Exploration of the Colorado River' (1875); Penck, 'Morphologie der Erdoberfläche' (1894); Davis, 'Physical Geography' (1901). See GEOLOGY; MOUNTAIN; PHYSICAL GEOGRAPHY; RIVER; SHORE.

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Eros'tratus, Ephesian incendiary. To perpetuate his name as the destroyer of one of the seven wonders of the world, he set fire to the magnificent temple of Artemis (Diana), at Ephesus, on the night Alexander the Great was born (356 B.C.). The indignant Ephesians decreed that whoever pronounced his name would be put to death, a sure means of insuring his fame.

Erot'ic (Greek *erōs*, love), relating to love. — Erotic poetry, amatory poetry. — The name of *erotic* writers has been applied to certain modern French fictionists, and in Greek literature, particularly to a class of romance writers, and to the writer of the 'Milesian Tales.' These writers belong to the later periods of Greek literature, and abound in sophistical subtleties and ornaments. The best of them are Achilles, Tatius, Heliodorus, Longus, Xenophon of Ephesus, and Chariton.

Erpenius, ĕr-pē'nĭ-ŭs (Latinized from *Von Erpe*), **Thomas,** Dutch Orientalist: b. Gorkum, Holland, 11 Sept. 1584; d. Leyden 13 Nov. 1624. His fame rests principally on his acquaintance with the Oriental languages. To extend his knowledge of them he visited England, France, Italy, and Germany, and became acquainted with the most eminent scholars. He learned at the same time the Persian, Turkish, and Ethiopian languages. He returned, in 1612, to Leyden, and was appointed professor of Arabic and other Oriental languages. He established a press, at great expense, for the printing of works of Oriental literature. In 1619 a second Hebrew professorship was founded at Leyden, and committed to Erpenius. Soon after he received the office of Oriental interpreter to the States-General. The most learned Arabs admired the elegance with which he expressed himself in their language, so rich in delicate peculiarities. His reputation as a perfect master of the Arabic became universal, and he was repeatedly invited by the king of Spain to explain inscriptions on the Moorish buildings and monuments. The works of Erpenius (some of which were published after his death), are held in the highest estimation. Beside his 'Grammatica Arabica,' his 'Grammatica Hebraica,' and other grammatical works, his most valuable and celebrated publication is his 'Elmacini Historia Saracenica' (1625).

Errante, Vincenzo, vĕn-chĕnd'sō ĕr-răn'tĕ, Italian poet and statesman; b. Palermo 16 July 1813; d. Rome 29 April 1891. He was many years an exile for his share in Sicilian politics. His works are two volumes of 'Tragedies and

Lyrics' (1874); the dramas 'The Feast of St. Felix' and 'Suleiman the Great'; the poems 'The Ideal' and 'Liberty.' He wrote also a 'History of the Osmanli Empire from Osman to the Peace of Carlowitz' (1882-3).

Errantia, ĕ-răn'shĭ-ạ, an order of annelids of the sub-class Polychæta, characterized by their not dwelling in fixed tubes, but wandering about freely, seeking animal food. They have a well-developed head, with protrusible pharynx usually armed with chitinous jaws, and efficient locomotary organs. A typical genus is *Nereis*, with many familiar species.

Errard, Charles, shärl ăr-rär, French painter and architect: b. Nantes 1606; d. Rome 15 May 1689. He was instructed in painting by his father, and perfected his knowledge at Rome. On his return to France he gradually rose to eminence in his profession. In 1648 he became one of the 12 founders of the Academy of Painting. He was engaged in the decoration of the Palais Royal, Louvre, and other palaces. His chief claim to notice rests, however, upon his connection with the foundation of the French academy at Rome, which was projected by him and carried into effect in 1666, with 12 pupils.

Errata, ĕ-ră'ta (Latin, the plural form of *erratum*, an error), the list of errors and corrections placed at the end or at the beginning of a book. Before the invention of printing, and for a short time after, the errata were corrected on the page where they occurred, but this was found to be inconvenient when the art became a little more developed. The first known example occurs in an annotated edition of 'Juvenal,' published at Venice in 1478, which contains a list occupying two pages. 'The Vulgate,' published in 1590, at Rome, by Sixtus V., and of which the proofs were revised by that Pope himself, contains, instead of a table of errata, a bull which excommunicated those who would dare to make any alterations in the text. The book, however, was found to contain so many blunders that it was afterward suppressed, and the Papal bull had no other effect than that of amusing the learned and creating a demand for the copies still existing, some of which have been sold for about $200. See BULL; MISTAKE.

Errat'ics, or **Erratic Blocks**, in geology, boulders or large masses of angular rock which have been transported to a distance from their original mountains by the action of ice during the Glacial Period. Thus on the slopes of the Jura Mountains, in France, immense blocks of granite are found which have traveled 60 miles from their original situation. See GEOLOGY; GLACIER.

Errera, Alberto, ăl-bĕr'tō ĕr-rä'rä, Italian political economist: b. Venice 21 April 1841. He was educated at Padua and has held the professorship of political economy and statistics in the schools of several Italian cities, including Venice, Milan and Naples, and also at the University of Naples. Among his works are: 'Storia e statistica delle industrie venete' (1870); 'Storia delle economia politica nei secoli XVII. e XVIII. negli stati della repubblica Veneta' (1877); 'Demographia' (1892); and 'Lezione di economia politica' (1892).

Er'rett, Isaac, American clergyman: b. New York 2 Jan. 1820; d. near Cincinnati, Ohio, 19 Dec. 1888. In 1840 he entered the ministry of the "Christian Church," a sect founded by Alexander Campbell, and held pastorates in Pennsylvania, Ohio, Michigan, and Chicago, Ill. For a time, he assisted Campbell in the editorship of the 'Millennial Harbinger,' in 1866 he established the 'Christian Standard,' and published it until his death. He was president of Alliance College 1868-9; filled many offices in his Church, and wrote: 'Brief View of Christian Missions' (1857); 'First Principles, or the Elements of the Gospel' (1867); 'Letters to a Young Christian' (1877); 'Evenings with the Bible' (1884-7); 'Our Position; the Plea Urged by the People Known as Disciples of Christ' (1885), etc.

Error, (1) In astronomy, errors or differences in calculations and observations, to correct which recourse is had to a system of reduction known as the method of least squares. (2) Clerical error, a mistake in writing, a slip of the pen. (3) Joiner in error, in law; the taking of issue on the suggestion of error. (4) Writ of error, in law, a process issued by a court of review, to an inferior court, suggesting that error has been committed and requiring the record to be sent up for examination; now commonly known as an appeal. (5) Court of error, a court exercising appellate jurisdiction by means of writs of error. (6) Assignment of error, in law, specification of the error suggested or objected to. For ordinary errors, see BULL; MISTAKE.

Error, Personal. See EQUATION, PERSONAL.

Ersch, Johann Samuel, yō-hän sä'moo-ĕl ersh, German bibliographer: b. Grossglogau 23 June 1766; d. Halle 16 Jan. 1828. He was principal librarian and professor of geography and statistics at Halle. Among his publications are: a 'Dictionary of French Writers'; 'Manual of German Literature'; and, in connection with Gruber, the 'Universal Encyclopædia of Arts and Sciences' (1818).

Erse, ĕrs, a corruption of the word Irish; a name applied to Irish Gælic people, and also to the lowlanders of Scotland. See CELTIC LANGUAGE AND LITERATURE.

Erse Language. See CELTIC LANGUAGE AND LITERATURE.

Erskine, ĕrsk'ĭn, **Ebenezer**, Scottish clergyman, the founder of the Secession Church in Scotland; b. Scotland 22 June 1680; d. Stirling, Scotland, 2 June 1754. He was ordained minister of Portmoak, in Fife, in 1703, in which situation he continued for 28 years, when he removed to Stirling. His attitude toward patronage and other abuses in the Church led to his being deposed, when, in conjunction with his brother and others, he founded the Secession Church. He was the author of several volumes of sermons. See MacEwen, 'The Erskines' (1900).

Erskine, Henry, Scottish barrister: b. Edinburgh 1 Nov. 1746; d. Ammondell, West Lothia, 8 Oct. 1817. He twice held the office of lord-advocate, was for long the leader of the Scottish bar, and had a high reputation as a wit.

Erskine, John, of Carnock, afterward of Cardross, Scottish jurist: b. 1695; d. near Dumbarton 1 March 1768. He was called to the Scotch bar in 1719, and was author of 'Principles of the Law of Scotland,' and the 'Institute of the Law of Scotland,' both authorities.

Erskine, Ralph, Scottish clergyman: b. 15 March 1685; d. Dunfermline 6 Nov. 1752. He was a brother of Ebenezer Erskine (q.v.). He was ordained to the parish of Dunfermline in 1711, and in 1737 joined his brother, who had seceded from the Established Church. His 'Gospel Sonnets' and other religious works were once very popular.

Erskine, Thomas, Baron Erskine, Scottish jurist: b. Edinburgh 21 Jan. 1750; d. there 21 Jan. 1823. He became a noted forensic orator and jurist, attaining most of his renown as a pleader in support of the accusations of corruption made against Lord Sandwich; later he added to his success by his defense of Stockdale, Hardy, Thomas Paine, Horne Tooke and others. He was a member of the House of Commons in 1790–1806. He was created Baron Erskine of Restormel, on becoming lord chancellor.

Erup'tion, a term applied to a local disturbance in the skin characterized by the formation of redness or scaliness, blistering or pustulation. In one class of affections, known as the eruptive fevers, a characteristic form of skin-eruption is diagnostic. Thus the fine red rash of scarlet fever, the bluish red rash of measles, the irregular rash of chickenpox and the pustulate rash of smallpox are readily recognized. The popular notion that an eruption is an indication of something evil within the body finding its way out belongs to the mediæval days of superstition and ignorance, when disease was regarded as an evil spirit to be exorcised, and gave notice of its evacuation by means of an eruption on the skin. At the present time we know that most eruptions are either of purely local occurrence, due to localized irritants, as in the case of pimples, boils, etc., or that they represent a disturbance of the nerve-centres, whose end-filaments are distributed to the epithelial structures of the body. Thus in measles, not only the skin, but also the mucous membranes of the respiratory tract are affected, the poison affecting the nerve-structures being evidenced by nerve-irritation at the periphery of the body. The popular idea that it is necessary to bring an eruption out in acute infectious diseases such as measles, scarlet fever, etc., is a trustworthy one, but an interpretation is frequently given to it that is not sound. The presence of an eruption on the surface of the body in these affections is an indication of the protective energies of the human organism in its fight with the infection and poisoning. The inability of the body to counteract the poison of the disease may prevent the development of the eruption, and thus its bringing out, being the sign of the body's ability successfully to cope with the poison, is the warrant for the popular idea of the efficiency of the eruption. Many drugs locally applied, or taken internally, cause the formation of eruptions. These eruptions may be due to purely nervous influences, or they may be of local origin. Drug-eruptions following the use of the iodides and bromides are of this latter character. As the drug is eliminated through the skin, its passage there causes local irritation and the formation of an eruption. See Dermatitis; Measles; Skin.

Erup'tive Rocks. See Igneous Rocks.

Erwin von Steinbach, ĕr'vēn fōn stīn'baн, German architect: b. Steinbach, Baden; d. 17 Jan. 1318. The principal tower of the cathedral of Strasburg had been completed in the 7th century. It was partly built of wood, and was reduced to ruins by lightning and successive fires. The nave, begun in 1015, was only completed in 1275. Erwin was then requested to furnish designs for the decoration of the interior of the church, and for the construction of two new towers and a façade upon the site of the ruins of the old tower. The foundation stone of the new structure was laid 25 May 1277. The architect died when the work was only half finished; it was continued by his son Johannes (died 18 March 1339), and subsequently continued chiefly after his designs, still preserved at Strasburg. His daughter Sabina assisted him in the decoration of the interior of the church; and another of his sons, Winhing (d. 1330), was also an architect of some distinction. The remains of this family of architects are interred within the cathedral.

Eryman'thus, in ancient geography, a river and mountain of Arcadia, in Greece. The river, according to some the modern Dimitzana, rises on the frontiers of Arcadia and Elis, and flows into the Alpheus. The mountain, situated to the east of the river, formed the western point of the northern barrier of Arcadia, and was covered with forests. It was in this mountain that Hercules chased and killed the famous wild boar.

Eryngium, ẹ-rĭn'jĭ-ŭm, a species of plants of the carrot family (*Umbelliferæ*). The generic name from the Greek refers to their thistle-like appearance. There are about 150 species in the genus, of which 22 are found in America. Rattlesnake-master, or button-snakewood (*E. aquaticum*) grows in wet soil and in the pine-barrens, from New Jersey south to Florida and west to Texas, Missouri, and Minnesota. Its common names are given to it because of its supposed efficacy as an antidote to the venom of snakes. A number of species are cultivated, both on account of the steel-blue color of the stem and branches, and of the unusual manner of growth. Eryngo (*E. maritimum*), sea-holly, is a native of England. It frequents sandy shores, and is distinguished from other plants of the order by its rigid, spiny, glaucous, veined leaves, and its dense heads of blue flowers. The roots are sometimes candied, and are reputed to be stimulating and restorative. Falstaff speaks of its use as a confection and its aphrodisiac qualities, either real or supposed, are mentioned by dramatists from Jonson to Prior.

Eryops, ĕr'ĭ-ops, a large fossil labyrinthodont amphibian, characteristic of the Permian Period in North America. The skull is 18 inches to 2 feet in length, very flat and broad.

Erysichthon, ĕr-ĭ-sĭk'thŏn, a legendary king of Thessaly, who, being guilty of sacrilege against Ceres, devoured his own flesh.

Erysimum, ĕ-rĭs'ĭ-mŭm, a genus of plants of the natural order *Cruciferæ*, chiefly biennials, with narrow entire leaves, and yellow, often fragrant, flowers. There are about 85 species, natives of northern temperate and cold countries. *E. cheiranthoides*, a native of Europe, with small yellow flowers, is found in waste places, along streams, and in fields from southern New England to Newfoundland, and westward to the

Pacific coast. The seeds of this plant were formerly employed as an anthelmintic, hence the name of wormseed. It is also called treacle-mustard, because used as an ingredient in the famous Venice treacle. The seeds of *E. perfoliatum* are used as a source of oil in Japan. Many of the plants formerly assigned to this species are now grouped in other genera, as *Sisymbrium*, etc.

Erysip'elas, an acute infectious disease of the skin and subcutaneous structures caused by a streptococcus. Whether the *Streptococcus erysipelatis* of Fehleisen, or the *Streptococcus pyogenes* is considered the causative factor or not, the fact remains that bacteriologically it is probable that these two forms of bacteria are identical. The reaction of the tissues to the streptococcus and its poisons causes the acute inflammation with redness, puffiness, and sometimes gangrene. This local swelling is attended with fever, headache, general constitutional symptoms, nausea, vomiting, and at times with toxic delirium. Occasionally the streptococcus wanders into the blood-stream, and general septicemia or pyemia results. At other times a streptococcic invasion of the joints produces an acute rheumatism with secondary heart complications. Erysipelas may affect any part of the body, but is very frequent over the face and head. It is extremely contagious, the organism finding entrance through minute wounds. Patients who have had recent erysipelas should on no account be allowed to come anywhere near women in childbirth, as puerperal fever may result. The treatment of erysipelas is by means of tonics — iron and quinine being favorites — nutritious and easily assimilable diet, milk, cod-liver oil, and some form of alcohol. In those patients in whom abscess formation occurs, prompt surgical evacuation is imperative. Local treatment by ichthyol and similar antiseptics is widely employed with some benefit.

Erythe'ma. See DERMATITIS.

Erythræan (ĕr-ĭ-thrē'an) **Sea**, in ancient geography, a name given to what is now called the Indian Ocean, but including the Persian and Arabian gulfs. The name was latterly restricted to the Arabian Gulf.

Eryth'ric Acid is obtained from lichens by extracting with boiling water or milk of lime. It is a white, crystalline, tasteless, and odorless powder, readily soluble in alkalies, and alcohol. See CHEMISTRY.

Erythrina, ĕr-ĭ-thrī'na. See CORAL-TREE.

Erythrite, e-rith'rit, or «cobalt bloom,» a native hydrous cobalt arsenate, having the formula $Co_3As_2O_8 + 8H_2O$. It has a beautiful peach-blossom red color, whence its name from the Greek, *eruthros*, red. It occurs in monoclinic crystals, but more commonly in globular or stellate masses or earthy. It occurs at Schneeberg, Saxony; in Cornwall, England; in Chile, and in some parts of the United States.

Erythro'nium, a genus of small plants of the lily family, common in damp, shady woods, of which a well-known and widespread species (*E. americanum*) in the United States, is the «dog-tooth violet» or «adder's tongue» — both unfortunate names. It is among the earliest of spring flowers, appearing as two radical leaves, usually handsomely mottled, between which rises a slender, naked stem (scape) three to four inches high, bearing a single bell-shaped flower of six distinct lanceolate petals, pale yellow, often spotted near the base. Some eight other species are known in the United States, some bearing several flowers on the scape, and of various tints, as purple, rose-color or pinkish white.

Erythrophlœum, ĕ-rĭth-rō-flē'um, a genus of tropical trees, of the pea family, containing three species, two found in Africa, and the third in Australia. The *E. guineense* of Africa has a poisonous red juice, which is used by the natives as a test of innocence or guilt, and hence the name ordeal-tree. The natives of Guinea and the Gold Coast employ the same juice to poison the points of their arrows.

Erythroxylon, ĕ-rĭth-rŏk'ĭ-lŏn, a genus of plants of the natural order *Erythroxylaceæ*. The family contains 30 species, composed almost exclusively of trees and shrubs; growing in tropical South America. The flowers are small and lack color; the fruit is a drupe. The red dye-wood of Brazil is *E. suberosum*, and the oil-wood of Mauritius is *E. hyperiifcolium*. The chief member of the genus and family is *E. coca*. See COCA.

Eryx, ē'rĭks, ancient name of a city and mountain in the west of Sicily, about six miles from Drepanum, and two from the seacoast. The mountain, now Monte San Giuliano, rises direct from the plain, unconnected with any other range, and hence possesses a much greater altitude in appearance than in reality, its height being only 2,184 feet. It was anciently believed to be the highest mountain in the island after Etna, and is frequently alluded to by Virgil and other poets. On the summit stood a celebrated temple of Venus, from which the goddess received the epithet of Venus Erycina. All traces of the ancient town of Eryx have now disappeared, and its site is occupied by the modern town of San Giuliano; but some remains of the temple still exist in part of the substructure of the castle.

Erzerum, ĕrz'room, **Erzeroum**, or **Erzeroom**, Turkey, a city of Armenia, and, since the annexation of Kars by Russia, the chief strategical centre and place of resistance to a Russian advance, about 100 miles southwest of Trebizond. Its fortifications have been repaired and much improved since 1864. The inhabitants consist of Turks, Armenians, and Persians, are very industrious; and, in addition to important manufactures, especially in copper and iron, carry on a very extensive trade. This is greatly favored by the position of the town, standing at the junction of several important roads leading from Transcaucasia by way of Trebizond, and communicating with different parts of Asia Minor, with Persia, Kurdistan, Mesopotamia, etc. The value of British goods imported into the town in 1898 was estimated at $244,000. Erzerum is a place of great antiquity. Anatolius, commander of the Emperor Theodosius II., here built the citadel of Theodosiopolis, northwest of the open Syro-Armenian trading town of Arsen. On the destruction of this town by the Seldjuks, in 1049, the inhabitants removed to Theodosiopolis, which received from them the name of Arsen-er-Rum, that is, Arsen of the Romans. Hence the modern name Erzerum. In 1241 it fell into the hands of the Mongols, and in 1517 into those of the Turks, notwithstanding whose mismanagement it continued to be the most important commercial emporium of the Armenian plateau, and had a population of 100,000. In 1829 it was taken by the Russians, but was restored to Turkey by the Peace of Adrianople. Many of the inhabitants, however, quitted the town and settled in the Russian territory. In the winter of 1877 it was besieged by the Russians, who reduced the defenders by famine, until in February 1878 it was surrendered, and held by the Russians for several months. It was again, however, restored to the Turks.

Erzgebirge, ĕrts'gĕ-bĕr-gĕ, a range of low mountains about 100 miles long on the boundary between Saxony and Bohemia. The mountains, like the Blue Ridge Mountains in the United States and the Highlands of Scotland, are an ancient range, worn down and again uplifted. As the name (Ore Mountains) implies, the Erzgebirge contain valuable deposits of minerals and form an old mining region. Silver ores were mined there as long ago as 1150 and mines of lead, copper, tin, cobalt nickel and iron ore have also been sunk there.

Esarhaddon, ē-sär-hăd'ŏn, Assyrian ruler: d. about 667 B.C. He was the son of Sennacherib, one of the most powerful of the Assyrian monarchs. He extended the empire on all sides, and is the only Assyrian king who actually reigned at Babylon.

Esau, the eldest son of Isaac, and twin brother of Jacob (Gen. xxv. 24-6). His name (which signifies rough, hairy) was due to his singular appearance at birth, being "red, and all over like an hairy garment." The struggle for precedence between the brothers was foreshadowed the moment of their first appearance in the world. Esau, the father's favorite, became a cunning hunter; Jacob, the favorite of the mother, became a peaceful shepherd. One day, as Esau returned famished from the chase, he found his brother preparing some lentil pottage, and asked for a share of it. Jacob, taking advantage of his brother's distress, offered him the pottage if he would give up his birthright. Although this meant yielding up the headship of the tribe and the greater share of the family property, Esau nevertheless consented. He was named Edom (red) in consequence, from the color of the pottage; and the name was given to the land he settled in. The next episode in his history is when Jacob, instigated by his mother, personated Esau, and succeeded in getting his father's covenant blessing. The indignation of Esau at the base trick was natural; and Rebekah sent Jacob out of the way for a time, to escape his brother's vengeance. On his return from a protracted stay Jacob succeeded in mollifying Esau by presents and flattery. After a subsequent meeting of the brothers, on the death of their father, we hear no more of Esau.

Esbjerg, ĕs'byĕrg, Denmark, seaport, 56 miles west of Fredericia, with a large export trade in cattle, and dairy products, mostly to England. Its harbor, the only one of importance on the west coast of Jutland, was constructed by the state at great expense in 1868–74; and in 1887 an annual subsidy was granted by government for steam communication with Great Britain. Pop. about 15,000.

Escalade, ĕs-kā-lăd', in war, a furious attack of a wall or a rampart, carried on with ladders, to pass the ditch or mount the rampart, without proceeding in form, breaking ground, or carrying on regular works to secure the men. See WAR.

Escalator, the name applied to a continuous carrier designed for conveying passengers from one level to another within a limited time. The various units making up the escalator are so arranged that on the incline they present the familiar zigzag appearance of an ordinary stairway, and may be used as such. The escalator consists of an endless series of steps connected together by a heavy sprocket chain which, at the proper place, engages with the driving sprocket wheel. Each step is essentially a four-wheel truck, bolted to a shaft, which in turn, is connected to the links of the driving chain. There are two wheels at each end of the truck traveling on separate tracks, so placed that the steps remain horizontal at all points of the ascent. At the landing, at the top and the bottom of the escalator, the trucks travel in the same plane so that the steps there become a moving platform. Ample opportunity is thus given, even to the infirm, to board the device before the ascent begins and, at the top to step off again. A traveling hand-rail moving at the same speed as the steps further simplifies its use. Should a person fail for any reason to step off at the upper landing, a device called a shunt, removes him from it. This consists of a box-like affair, triangular in plan, placed about 10 feet from the top of the escalator with the apex pointing against the direction of the moving platform. In the lower part, set in a vertical position are two belts running backwards from the apex. Anything coming in contact with these belts is gently brushed to one side. Every part of the escalator is made to micrometer measurements to one thousandth of an inch by special machinery designed for the purpose. As a result of this unusual precision, the various steps fit together so nicely that a piece of paper cannot be forced between them. To secure practically noiseless operation, the wheels on which the trucks move are deadened, rawhide pinions are used in driving gear, and the tracks are built up of wood and steel. The links of the sprocket chain are made of two 18 inch cast steel shrouds, with 1½ inch steel pins between them at 3 inches between centres. The ends of the links are bushed with phosphor-bronze in which graphite is inlaid, thus providing lubrication of the bearing surfaces, and the wheels are similarly provided with a constant lubrication of graphite. The escalator is driven by an electric motor located within the structure of the upper landing and suitably geared to the large driving sprocket wheel by a combination of worm and spur gearing. All parts of the running gear are made of crucible cast steel, the axles and link pins being of cold drawn steel. Each casting is subjected to a test of many times the working-strain to come upon it.

While there are no mechanical limitations to the rate of speed with which the escalator may be driven, it has been found that a speed of about 100 feet per minute is satisfactory to the public. At this rate of driving, 4,000 steps per hour arrive at the landing and the maximum capacity of the machine depends upon the width of the steps used. The escalators which have been installed for railroad stations, large department stores and other localities where a large capacity is necessary, have been a little over five feet in width and as each step readily accommodates three people the maximum capacity of such a construction is 12,000 people per hour. For the smaller department stores and for use in railroad stations where the traffic is not heavy the escalator is made of such width as to accommodate one person on each step, and the capacity is therefore 4,000 per hour. It should be noted that the escalator is a perfectly reversible machine, operating equally well in either direction. In the «duplex» type, the steps during the descent are again guided into the familiar zigzag position by suitably placed tracks and thus the same machine serves to carry passengers both up and down. In a third modification of the device designed especially for the London underground railroads, where the difference between levels is considerable, the steps ascend in one spiral and descend in another spiral below the first.

Charles D. Seeberger.

Escanaba, ĕs-ka-nä′ba, Mich., city, county-seat of Delta County, on Little Bay de Nouquette, an inlet of Green Bay; on the Chicago & N. W., and the Chicago, M. & St. P. R.R.'s; 52 miles northeast of Marinette. It is the grain and vegetable raising and lumbering centre of the country and an important iron-shipping point; it has five docks for iron ore, and an excellent dock for the shipping of other products. It has a public high school, St. Joseph's high school, public library, daily and weekly newspapers, and a national bank. Pop. (1910) 13,194.

Escandon, Guillermo de Landa y, Mexican statesman: b. Mexico City. He was educated in Stonyhurst University, England; was several years a member of the national senate, representing the states of Chihuahua and Morelos; from 1900–02 was mayor of Mexico City; and became governor of the Federal District in 1903. Under his administration many very important reforms have been introduced and carried to successful results, among them the restriction or practical discontinuance of gambling; the improvement of the public carriage service; the enactment of rules restricting the speed of automobiles; the protection of the Peon or Indian class; the improvement of the prisons of the capital city and its suburbs, and also of the public buildings and military barracks; the bettering of the sanitary condition of the correctional schools, the theatres and other places of amusement, and of the entire city; the adoption of a system of street sweeping and sprinkling; the placing of proper restrictions on the sale of alcoholic beverages, etc.

Escape′ment, a part of the machinery in a watch or clock. See Clock; Watchmaking.

Escarp′ment, the abrupt descent, which may or may not be a cliff, from a plateau to lower land. See Mountain; Cliff.

Escara. See Eskers.

Eschalot, esh-a-lŏt′. See Shallot.

Eschatology, ĕs-kā-tŏl′ō-jĭ (Gr. *eschatos*, «last,» and *logos*, «a discourse»), the doctrine of the last things, a theological term for what Scripture reveals and Christian speculation has concluded about a future state. But although the term is thus limited, an eschatology existed among all the great nations of antiquity, dark and ill defined as in the Greek, or elaborate as in the Egyptian religion. Together with it grows up more or less definitely the idea of retribution. See Theology.

Escheat′, the reversion of property to the sovereign. The law considers that all property must have an owner; so if a person die intestate and without issue, the property, in England, escheats to the king, and in America to the State as sovereign. In some jurisdictions, before the sovereign receives title there is a certain kind of proceeding to determine whether or not there are any heirs, while in other jurisdictions the sovereign gets the title on the death of the owner; but even in these cases the sovereign's title is defeasible until there are proceedings to determine that the deceased had no heirs. When the sovereign obtains title by escheat it acquires all the rights and privileges of the last owner, and the statutory requirements must be strictly followed, both as to the disposal of the property and as to the use of the fund derived from the sale, in case a sale is necessary. In the United States the powers and duties of the sovereign in relation to escheated property are controlled by statute in the different states.

Eschenbach, Wolfram von, vōlf′räm fōn ĕsh′ĕn-bäн, German mediæval poet: b. Eschenbach, near Ansbach, Bavaria; d. about 1220. He was one of the most prominent minstrels at the court of Hermann, Landgraf of Thuringia; and his epics rank among the greatest German imaginative works. Besides several love songs he wrote 'Parzival'; 'Wilhelm von Orange,' and 'Titurel, or the Guardian of the Graal.'

Eschscholtz, Johann Friedrich, yō′hän frēd′rĭн ĕsh′shōlts, Russian naturalist: b. Dorpat, government of Riga, 12 Nov. 1793; d. there 19 May 1834. He studied medicine in his native city, and in 1819 became professor of anatomy and director of the zoological museum of the University of Dorpat. In 1815–18 and 1823–6 he accompanied Otto von Kotzebue in the latter's exploring tours around the world, collected a large number of natural history specimens, and made valuable scientific studies on the lower organisms of deep-sea life. The results of his studies were published in Kotzebue's account of the expedition (1821), and he presented his collections to the University of Dorpat 1826. His catalogue of over 2,000 animals was published in Kotzebue's 'Neue Reise um die Welt' (Vol. II. 1830). Adelbert von Chamisso, another member of these expeditions, named a botanical species *Eschscholtzia* in his honor, and Eschscholtz Bay, on the Alaska coast, is also named after him. He published: 'Ideen zur Aneinanderreihung der rückgrätigen Tiere' (1819); 'System der Akalephen' (1829); 'Zoologischer Atlas' (5 parts, 1829–33), containing plates and distributions of new species of animals.

Eschscholzia, ĕ-ṣhōlt′sĭ-ạ, or **California Poppy,** a genus of annual and perennial herbs of the natural order *Papaveraceæ,* natives of the Pacific slope of the United States. The species, of which there are about a dozen, are distinguished by much dissected alternate leaves, yellow or white showy flowers (the sepals united to form a deciduous hood), and a long capsular fruit resembling a silique. The best-known species is probably *E. californica,* a perennial which is widely cultivated as an annual in flower gardens, and is a beautiful orange-colored flower, one of the most showy in the whole floral kingdom. It is gregarious in habit, and in California it covers large areas with an almost unbroken orange-yellow bloom of striking beauty when seen on the gray-green slope of a treeless hillside. It is easily raised, especially if the seed be sown soon after gathering in the fall, and the young plants protected in cold climates with a light mulch of straw or leaves. Spring-sown seed is usually less satisfactory since it is less viable. The name is erroneously spelled «Eschscholtzia.»

Eschwege, ĕsh′vā-gĕ, Germany, a town of the Prussian province of Hessen-Nassau, on the Werra, 26 miles east-southeast of Cassel. It is a walled and well-built town, with a castle, long the residence of the landgraves of Hessen-Rotenberg, but now used as a public building. It has manufactures of woolen and linen cloth, several large tanneries and glue-works, oil and other mills, and a trade in meal, fruit, lard, ham, and sausages. Pop. 11,341.

Eschweiler, esh′vī-lĕr, Germany, town in the Prussian Rhine province, nine miles east-northeast of Aix-la-Chapelle, at the confluence of the Inde and Dente. It has manufactures of articles in iron and tin-plate, zinc and copper, machinery, boilers, railway plant, needles, wire, rolling-mills, smelting furnaces, etc. Calamine and lead, as well as productive coal-mines, are worked in the vicinity. Pop. 22,654.

Es′chynite. See ÆSCHYNITE.

Escobar y Mendoza, Antonio, än-tō′nē-ō ĕs-kō-bär′ ē mĕn-dō′thä, Spanish casuist: b. Valladolid 1589; d. 4 July 1669. Entering the order of the Jesuits in 1604, he became celebrated as a preacher and writer. At his death he left more than 40 volumes in folio, mostly in theology and morality, the principal being the casuistical ‘Liber Theologæ Moralis’ (1646), which has several times been printed.

Escobedo, Mariano, mä-rē-ä′nō ĕs-kō-bā′-dō, Mexican soldier: b. Dos Arroyos, New Leon, 12 Jan. 1827; d. Tacubaya 22 May 1902. When the war between Mexico and the United States broke out he was a muleteer in charge of a string of pack mules belonging to his father. He converted his muleteers into a band of guerrillas, attacked small detachments of the American troops wherever he found them, and took part in the battles of Palo Alto and Resaca. Juarez commissioned him colonel in 1859. In 1861, upon the establishment of Juarez' government in the City of Mexico, Escobedo was made a brigadier-general and sent in pursuit of the Clerical forces under Marquez and Mejia, but was surprised, taken prisoner after an heroic defense, sentenced to be shot, but escaped and returned to Juarez. He took a prominent part in the engagements with the French which followed the intervention of Napoleon III. in Mexican affairs. He repulsed them at Puebla 5 May 1862, took part in the long siege of that place, and when it was captured by the French 17 May 1863, was taken prisoner, but succeeded in escaping. When Maximilian's empire was established, Escobedo took up his headquarters in Texas, secretly purchased arms and ammunition in New Orleans, 1865, organized and equipped a force of Mexican refugees, American negroes, and ex-Confederate soldiers, led them into Mexico, captured the imperial garrison at Monterey November 1865, and swept everything before him. Juarez appointed him commander-in-chief of the Army of the North; he continued his victorious course until all the chief cities were in the hands of the republicans, and finally besieged and defeated the emperor at Queretaro 15 May 1866. It is said that Maximilian offered his word of honor to Escobedo, on surrendering his sword, to leave the country at once if conducted to the nearest port; but Escobedo refused, ordered a court-martial to be instituted, and the emperor was condemned and executed. In 1874 he quelled an uprising against the government of Juarez, but was unsuccessful in putting down the revolution started by Gen. Diaz. He fled to Texas, issued a manifesto against Diaz, returned, was arrested and tried, and notwithstanding the government's efforts to convict him, was acquitted. To escape petty persecutions he went to New York 1879–80, but returned, and was appointed president of the supreme military court of justice 1882–3, when he retired at last to private life.

Esco′rial, or **Escu′rial,** a royal palace of Spain, distant from Madrid about 24 miles in a northwesterly direction, and situated on the acclivity of the Sierra Guadarrama, the range of mountains which divides New from Old Castile. The Escorial combines a monastery, a church, and a mausoleum with a royal palace. Everything about the Escorial — situation, plan, and purposes — bears the stamp of the singular and unpractical mind of its originator, Philip II. Not the least remarkable of its peculiarities is its site. Away from cities, amid the seclusion of mountain scenery, it stands at a height of 2,700 feet above the level of the sea. It was built in commemoration of the battle of St. Quentin, which was fought 10 Aug. 1557. The building is a rectangular parallelogram measuring 744 feet in length by 580 in breadth. The interior is divided into courts; while a projection 460 feet in length contains the chapel and the royal palace. The building was begun in 1563 by Juan Bautista de Toledo, a Toledan architect, and finished in 1584 by his pupil Juan de Herrera. It is irregular in its proportions, and thus loses much of the effect which, from its great magnitude, it ought to have. The innumerable windows (said to be 11,000 in honor of the Cologne virgins) give it the aspect of a large mill or barrack. The doors are also numerous. The material of the building is gray granite found in the neighborhood, which preserves its fresh and clean appearance. The church, situated immediately in front of the palace, is 320 feet long and 230 broad; and under it is the Pantheon or burying-place of the kings of Spain. Its interior is lined with dark marble beautifully veined. The monasterial part of the building contains a valuable library, especially rich in Greek and Arabic manuscripts, and there is a superb collection of pictures scattered through various parts of the building. Raffaele, Titiens, Rubens, Velasquez, Guido, and other great masters are here represented. During the French occupation the books, 30,000 in number, were removed to Madrid, but were sent back by Ferdinand minus 10,000 volumes. The Escorial was partly burned in 1671, when many MSS. were destroyed. It was pillaged by the French in 1808 (when the books were removed) and in 1813. It was restored by Ferdinand VII., but the monks, with their revenues which supported it, have long since disappeared, and the building, which from its situation requires to be kept in repair at considerable expense, has fallen into some decay, though repairs are executed from time to time. On 2 Oct. 1872 it was struck by lightning, and was in consequence seriously injured by fire. The monastery portion of it is now a seminary in which youths receive a secular education. The Escorial is 32 miles by railway from Madrid.

Escort, a guard, a body of armed men which attends an officer or baggage, provisions or munitions, conveyed by land from place to place, to protect them. This word is sometimes used for naval protectors; but the proper word in this case is convoy. In the United States escorts are of two kinds, funeral escorts and escorts of honor. The army regulations fix the character and size of escorts according to the military prominence or title of the individual.

Escosura, Patricio de la, pä-trē'thē-ō dā lä ĕs-kō-soo'rä, Spanish novelist and poet; b. Madrid 5 Nov. 1807; d. there 22 Jan. 1878. After various political and military ups and downs and being twice exiled, in 1855 he was sent as a special envoy to the Portuguese court, became under-secretary of state, minister of the interior, and afterward ambassador to Germany, 1872–4. He wrote the historical novels: 'The Count de Candespina' (1832); 'Neither King nor Pawn' (1835); and 'The Patriarch of the Valley'; the epics 'The Bust in Black Cloak' and 'Hernan Cortés at Cholula'; several dramas, the most successful of which was 'Hernan Cortés' Debaucheries'; and several historical works, among them a 'Constitutional History of England' (1859).

Escott, Thomas Hay Sweet, English journalist: educated at Queen's College, Oxford, and since 1865 actively connected with London journalism. He has been a leading article writer for the 'Standard' since 1866 and succeeded John Morley (q.v.) as editor of the 'Fortnightly Review.' He has published: 'England: Its People, Polity and Pursuits' (1897); and its sequel, 'Social Transformations of the Victorian Age' (1897); 'Politics and Letters' (1886); 'Lord Randolph Churchill: a Monograph' (1895); 'Personal Forces of the Period' (1898); 'A Trip to Paradoxia' (1899). He has also published an edition of 'Juvenal and Persius.'

Escuage, ĕs'kū-āj. See SCUTAGE.

Escuer'zo, a Spanish term for "toad," specifically applied in the valley of the La Plata to a large local toad-like frog (*Ceratophrys ornata*) noted for its varied colors, laid on like those of a Persian carpet. This patchwork thoroughly conceals them as they lie half-buried in the ground. "If there is not enough green vegetation," says Gadow, "they throw, with their feet, little lumps of earth upon their backs, the skin of which becomes at the same time more wrinkled and assumes duller tones. There the creature lies, perfectly concealed, betrayed only by the metallic, glittering eyes, waiting for some unfortunate creature to pass into the trap represented by the enormous mouth, which opens and shuts with lightning rapidity and an audible snap." These frogs are of the Cystignathine group (see FROG) and closely allied to the monstrous "horned toads" of Brazil. They live chiefly on frogs and are sometimes cannibals.

Escuintla, ĕs-kēn'tlä, Guatemala, one of the southern departments of that republic; population about 32,000. Its chief town, also called Escuintla, situated at an altitude of 1,269 feet above the level of the sea, on the line of the Central Railroad and half way between Guatemala city and the port of San José, has good hotels and apartment houses, and is a favorite winter resort. Pop. of Escuintla city about 12,350.

Es'culin, Es'culine. See ÆSCULIN.

Escutcheon, ĕs-kŭch'ŏn, in heraldry, is derived from the Old French *escusson*, French *écusson*, and that from the Latin *scutum*, a shield. It signifies the shield whereon coats of arms are represented. See HERALDRY.

Esdraelon, ĕs-drā-ē'lŏn or ĕs-drā'ẹ-lŏn (Merdj-Ibn-Amer), the famous and beautiful plain in Palestine, situated between the mountains forming the western watershed of the Jordan and the Mediterranean Sea. Other names by which it is called in the Old Testament are Jezrael, valley of Megeddo, and the Great Plain. It is triangular in form, 36 miles in length, with an average width of 15 miles. On its boundary are: on the northeast Mount Tabor, the southeast Mount Gilboa, and on the southwest Mount Carmel. The principal streams are Nahr-el-Djalood, which flows into the Jordan, and the Kishon (Nahr-el-Moukataa) which flows into the Bay of Acre just north of Mount Carmel. Other streams traverse the plain, but are chiefly branches of the two streams mentioned. The soil is fertile and when cultivated with care yields good crops. When Esdraelon was traversed by caravans crossing Palestine from the rich countries east and west, grains, vegetables, and fruits were raised in abundance. Agriculture is again receiving attention. Some of the noted places on this plain are Djeneen (probably the old town of Engannin), at the entrance to the plain and 984 feet above the sea. Tradition says this is where the 10 lepers were cured (Luke xvii.); Zerlin, known by the residents as Zeraeen, called by the Crusaders Petit-Guérin, is now a large village. Near it is the fountain, Ain-Maeeteh, supposed to be where Saul camped when at war with the Philistines (1 Sam. xxxi). Ain-Djalood, said to be the place where Gideon selected the 300 men who fought and defeated the Midianites (Judge vii.). On the south side of the Kishor are the villages of Afooleh, El-Fooleh and Zerin. Afooleh is the old town of Aphec, one of the places where the Assyrians and Egyptians met in battle. At El-Fooleh was once a fortress built by the Templars, but destroyed by Saladin in 1187. Here was fought the battle between the French under

Napoleon, 4,000 in number, and the Mohammedans, 35,000 in number, in which the French were victorious. Ruins of the fort exist. For the ancient history of Esdraelon consult the Old Testament; many of the important places mentioned in the New Testament are in a good state of preservation. Nazareth, Nain, and all the surrounding section west of Mount Tabor, are usually included in the plain, and must be so considered if Mount Tabor is accepted as on the northeast boundary. Consult: Thomas, ‘Two Years in Palestine’; Sayce, ‘Patriarchal Palestine’; Costello, ‘The Gospel Story’; Smith, ‘Historical Geography of the Holy Land.’

Es'dras, Books of, two apocryphal books, which, in the Vulgate and other editions, are incorporated with the canonical books of Scripture. In the Vulgate the canonical books of Ezra and Nehemiah are called the first and second, and the apocryphal books the third and fourth books of Esdras. The Geneva Bible (1560) first adopted the present nomenclature, calling the two apocryphal books first and second Esdras. The subject of the first book of Esdras is the same as that of Ezra and Nehemiah, and in general it appears to be copied from the canonical Scriptures. The second book of Esdras is supposed to have been either of much later date, or to have been interpolated by Christian writers. This book takes its name from the supposed writer, a priest and doctor of the law, called Ezra by the Hebrews.

Es'erin, or **Physostigmin,** a drug obtained from Calabar-bean, the active principle of this plant, used as a remedy in cases of tetanus (lockjaw). A solution of eserin dropped in the eye causes contraction of the pupil, and hence its use in some eye ailments, as, for instance, glaucoma.

Esh'er, Reginald Baliol Brett, 2d Viscount, English writer: b. London 30 June 1852. He was educated at Eton and Cambridge, and was private secretary to the Marquis of Hartington, then leader of the Liberal party, 1878–85. He was member of Parliament for Falmouth 1880–5, and in 1895 was appointed secretary to H. M. Office of Works, a post he retained until 1902. He succeeded his father as viscount in 1899. He has written: ‘Footprints of Statesmen’ (1892); ‘The Yoke of Empire’; and many historical and political articles in the ‘Fortnightly Review’ and ‘Nineteenth Century.’

Esh'er, England, village in Surrey, 15 miles southwest of London. Claremont Palace, where the Princess Charlotte resided and died, is in the neighborhood. Pop. 2,516.

Esk (Celtic for water), the name of two small rivers in England, one in Cumberland and one in Yorkshire; and of several in Scotland, the chief being the Esk in Dumfriesshire; the North Esk and South Esk in Forfarshire; and the North Esk and South Esk in Edinburghshire.

Es'kers, Eskars, or **Eschars,** deposits of gravel and sand evidently caused by the drift beneath the ice sheets of the Glacial periods. Such deposits are found in the northern part of North America, in Ireland where they are called escarks; in Scotland where they are known as kaims or kames; in Sweden as ösars. They sometimes consist of long ridges of sand and gravel, 40 and 50 feet high, and again are in large triangular masses, as in Sweden where the forms are very irregular. See Glacier; Glacial Period.

Eski-Sagra, ĕs'kĭ-sä'grä, or **Ezki Zaghra,** Rumelia, a town in the eastern part, on the south slope of the Balkans, about 100 miles northwest of Adrianople. It is near the chief passes of the Balkan Mountains, and its trade is increased because of its location. The mineral springs and extensive rose gardens nearby are sources of wealth for the town. Some of the manufactures are carpets, coarse linen, leather, and rose oil. It is one of the South Balkan strongholds which repelled the Russians in 1887.

Eski-Shehr, ĕs'kĭ-shĕhr' (ancient Dorylæum), Turkey, a town 90 miles southeast of the Sea of Marmora. It has warm mineral springs, and manufactures of meerschaum pipes from the deposits of meerschaum in the neighborhood. The region of Asia Minor surrounding Eski-Shehr is noted for the quantity and quality of the meerschaum deposit. About two thirds of the people are Mohammedans and the remainder are Christians. Pop. 19,615.

Eskilstuna, ĕsk'il-stoo-nä, Sweden, city on the river of Eskilstuna, connecting Lake Maelar with Lake Hjelmar. It has daily communication with Stockholm, both by steamers and rail. On an island in the river is a large gun-factory, and its manufactures of iron and steel products are so great that it is called the «Sheffield of Sweden.» The place takes its name from Saint Eskill, an English missionary of the 11th century, who, it is said, was martyred at a pagan assembly held where the city of Eskilstuna now stands.

Es'kimo Dog, the draft animal of the Arctic regions. It is a wolfish-looking dog, largely or sometimes wholly derived from the wolf, tinged with yellow or with a grayish color, having an outer coat of long hair, and an under-coat of soft wool. Its short pricked ears and bushy tail add to its wolf-like appearance. Its cry is not a bark, but a long melancholy wail. This dog is trained to hunt the polar bear and to drag the Eskimo's burdens over the rough ice, when harnessed in «trains» to sledges, and is highly prized in the frozen North.

Eskimos, or **Esquimaux,** es'ki-mō, the name of the inhabitants of the northern coast of the American continent down to lat. 60° N. on the west, and 55° on the east, and of the Arctic islands, Greenland, and about 400 miles of the nearest Asiatic coast. They have been met with as far as Arctic discoverers have hitherto advanced toward the pole. They prefer the vicinity of the seashore, from which they rarely withdraw more than 20, and hardly ever 80 miles. Their number scarcely amounts to 40,000. Nevertheless they are scattered as the sole native occupants of regions stretching 3,200 miles in a straight line east and west, to travel between the extreme points of which would necessitate a journey of no less than 5,000 miles. This distance, taken in connection with their homogeneous nature and manners, makes their small bands the most thinly scattered people of the globe. Their extraordinary persistency in maintaining their language and habits must be due to the difficulties they have had to face in procuring subsistence where no other nation can live. They call themselves *Innuit* («the people»).

Race.— They used to be classed among nations of the Mongolian stock; but now they are considered as akin to the American Indians. Their height nearly equals the average of the Indians. They appear comparatively taller sitting than standing. Their hands and feet are small, their faces oval, but rather broad in the lower part; their skin is only slightly brown; they have coarse black hair and very little beard. The skull is high.

Habits.— The Eskimos get their subsistence mostly from hunting by sea, using for this purpose skin boats where the sea is open, and dog sledges on the ice. From the skin, blubber, and flesh of the seal and the cetaceous animals, they procure clothes, fuel, light, and food. Their most interesting as well as important invention for hunting is the well-known small skin boat for one man, called a kayak. It is formed of a framework covered with skin, and, together with his waterproof jacket, it completely protects the man against the waves, so that he is able to rise unhurt by means of his paddle, even should he capsize. In winter the Eskimos are undoubtedly stationary. But during the summer, when sufficient open water is found, they roam about in their large skin boats. Their winter dwellings vary with regard to the materials of which they are built, as well as in their form. In the farthest west they are constructed mostly of planks, covered only with a layer of turf or sod; in Greenland the walls consist of stones and sod; in the central regions the houses are formed merely out of snow. In Alaska the interior is a square room, surrounded by the sleeping places, with the entrance on one side, while a hearth with wood as fuel occupies the middle of the floor. The number of inhabitants at an Eskimo station or village is generally under 40, but in rare cases more than 200 are found. A funnel-shaped, half-underground passage forms the entrance of the narrow dwellings.

Dress.— The dress of the Eskimos is almost the same for the women as for the men, consisting of trousers or breeches and a tunic or coat fitting close to the body, and covering also the head by a prolongation that forms the hood. For women with children to carry, this hood is widened so as to make it an excellent cradle, the amaut. Tattooing has been general among all the tribes. The ordinary materials of which clothes are made are the skins of seals, land animals, and birds.

Language.— The language is characterized by the power of expressing in one word a whole sentence in which are embodied a number of ideas which in other languages require separate words. The Greenland dictionary contains 1,370 radicals and about 200 affixes. A radical may be made the foundation of thousands of derivatives, and a word can be composed which expresses with perfect distinctness what in our civilized languages might require 20 words. In Greenland and Labrador the missionaries have adapted the Roman letters for reducing the native language to writing. The printed Greenland literature, including what has been published by the Moravian Brethren, amounts, with pamphlets and the like, to what might make 70 to 80 ordinary volumes.

Sociology.— It is doubtful whether an organization like that of the Indian "families" has been discovered among the Eskimos. But a division into tribes, each with their separate territories, actually exists. The tribe again is divided into groups constituting the inhabitants of the different wintering places. Finally, in the same station, the inhabitants of the same house are closely united with regard to common housekeeping.

Religion.— The inhabitants of Danish West Greenland, numbering about 10,000, the greater part of the Labradorians, and the southern Alaska Eskimos are Christianized. As for the rest, the religion of the Eskimos is what is generally designated as Shamanism.

The name Eskimo is said to be formed by corruption out of an Indian word signifying "eaters of raw meat." Their origin generally has been derived from Asia, but now they are believed by some to have come from the interior of America, and, following the river courses, to have arrived at the Arctic sea, where they have developed their abilities as an Arctic coast people. The Eskimos may be divided into the following groups: (1) The Western Eskimos, inhabiting the Alaska territory and the Asiatic side of Bering Strait; (2) the Mackenzie Eskimos, or Tchiglits, from Barter Island to Cape Bathurst; (3) the inhabitants of the central regions, including the Arctic Archipelago; (4) the Labradorians; (5) the Greenlanders. A side branch inhabits the Aleutian Islands.

The Christianized natives still preserve their ancient folklore. It represents at the same time their original poetry, religious ideas, and history, praising the deeds of their great men in braving the dangers to which their race has been continually subjected. The 'Tales and Traditions of the Eskimo' (1875) comprise a collection of 150 tales founded on versions supplied by about 50 narrators from different parts of Greenland, and a few from Labrador. A valuable collection has since been acquired from East Greenland, some tales from Baffin Land, and a number of the simplest fragments of the same from Bering Strait. See ALASKA; ARCTIC EXPLORATION; ETHNOLOGY; GREENLAND; LABRADOR.

Bibliography.— McLean, 'Notes on the Hudson Bay Territory' (1846); Hall, 'Life with the Eskimos' (1864); Rink, 'The Eskimo Tribes' (1887); Pilling, 'Bibliography of the Eskimo Language' (1888); Peary, 'My Arctic Journal' (1893); Nansen, 'Eskimo Life' (1894).

Es'ler, Erminda Rentoul, Irish novelist: b. Ireland. She married Robert Esler, M.D., in 1883. She has published: 'The Way of Transgression' (1890); 'The Way They Loved at Grimpat' (1894); 'A Maid of the Manse' (1895); 'Mid Green Pastures' (1895); 'The Wardlaws' (1896); 'Youth at the Prow' (1898); 'The Awakening of Helena Thorpe' (1901).

Esmann, ĕs'män, **Gustav Frederik,** Danish dramatist: b. Copenhagen 17 Aug. 1860. After a short period of legal study, he abandoned law for literature, and his first work was a volume containing two short stories, 'Gammel Gjæld' (1885). Thereafter he devoted himself mainly to dramatic composition, and a notable series of plays, which have been acted with great success throughout the Scandinavian countries, have come from his pen. They are: 'I Stiftelsen' (1886); 'Enkemænd'; 'Før Bryllupet'; 'I Provinsen' (1890); 'Den Kære Familie' (1892); 'Magdalene' (1893); 'Den Store Maskerade'

(1895); 'Vaudrefalken' (1898); 'Det Gamle Hjem' (1899); 'Sangerinden' (1901).

Esmarch, Johannes Friedrich August, yō-hän'nĕs frēd'rĭн ow'goost ĕs'marн, German military surgeon: b. Tönning, Schleswig-Holstein, 9 Jan. 1823; d. 23 Feb. 1908. He received his medical and surgical education in the universities of Kiel and Göttingen, and in 1860 was appointed director of the Kiel Hospital. In 1870 he was a member of the hospital commission of the Prussian army and introduced a system of bloodless operations. In the autumn of 1888 he made a trip to the United States. He was an authority especially on gunshot wounds.

Esmeraldas, ĕs-mā-räl'däs, **Ecuador,** a province, etc. See Ecuador.

Esneh, ĕs'nĕ, or **Esne,** a province in upper Egypt, situated on both banks of the Nile. The town of the same name, which is the capital of the province, stands about 30 miles above Thebes on the left bank of the river. It is a seat of manufactures, and produces blue cotton cloth and pottery, and is a depot of caravans from Abyssinia and Sennaar. The town was anciently called Latopolis; and was the centre of worship of the fish latus, a species of carp. Among the ruins of this once populous city is the temple, whose portico is in good preservation, having 24 beautiful columns, and a zodiac on the ceiling. Pop. 12,000.

Esocidæ, ĕ-sŏs'ĭ-dē. See Lucidæ.

E'sopus War, a long-continued and desultory conflict between the Dutch and the Indians at a place in Ulster County, N. Y., known to the Indians as Esopus, but now called Kingston. This series of skirmishes began in 1658, when the Dutch fired upon some Indian farm hands, who were drunk and riotous. Esopus, which the Dutch called Wiltwyck, was at last destroyed by the aborigines, who carried off 40 women and children, and killed 21 men. Gov. Stuyvesant sent out a strong force to punish the Indians, and in May 1664 a treaty of friendship was ratified.

Esoteric, ĕs-ō-tĕr'ĭk (Gr. *esōterikos,* "inner"), a term used in opposition to exoteric. In reference to the teaching of Pythagoras, Aristotle, and other ancient philosophers, it refers to those doctrines which they expounded to their select disciples, in contradistinction to those which they published to all the world (exoteric). The distinction does not necessarily imply that the esoteric doctrines were kept secret as a mystery, but only that they were of a higher and more difficult order. See Aristotle; Pythagoras.

Espalier, ĕs-păl'yĕr, in gardening, a sort of trellis-work on which the branches of fruit-trees or bushes are extended horizontally, with the object of securing for the plant a freer circulation of air as well as a full exposure to the sun. Trees thus trained are not subjected to such marked nor so rapid variations of temperature as wall-trees. The term is most commonly used in France, where it is applied to a row of trees planted along a wall. See Trellis.

Espartero, Baldomero, bäl'dō-mā'rō ĕs-pär-tā'rō, Duke of Vittoria, Spanish statesman: b. Granatula 27 Feb. 1792; d. Logrono 9 Jan. 1879. The son of a wheelwright, he was educated for the priesthood, but joined the army as a volunteer in 1808. He took a leading part in the conflict with the Carlists, and was one of the most prominent men in Spain during several decades of the 19th century. He was regent of the kingdom in 1841–3, and again head of the government in 1854–6. In 1868 his name was put forward in the Cortes as a candidate for the throne, but the proposal was unsuccessful and the closing years of his life were spent in retirement.

Espar'to (Gr. *spartos;* Lat. *spartum*), a grass, the *Stipa* or *Macrochloa tenacissima,* growing native in Spain and Africa, known to the ancients, and applied by them to the manufacture of cordage, matting, etc., and still more extensively used at the present day. A few species of *Stipa* are found in dry woods from New England, west to Wisconsin. Esparto grows in tufts and bunches, like rushes, to a height of from two to four feet, and has a long, flat, lanceolated blade, which becomes cylindrical when the ripened plant begins to dry. It is pulled up by the roots, dried in the sun, and packed in bundles for exportation. Besides the various uses already indicated, esparto has for some time been applied to the manufacture of paper. Formerly the supply of esparto was almost wholly obtained from Spain, but a closely allied fibre called alfa (*Macrochloa arenaria*) is now obtained in still larger quantity from Algeria, while a third fibre, dis (*Festuca patula*), is imported for the same purpose from Tripoli and Tunis. See Feather Bunch-grass; Fibre.

Esperanto Language. "Esperanto," successor to "Volupuk" in the effort to establish an international language, has made considerable progress. The latest reports, which include a statement of events at the Congress of Esperantists held at Boulogne from 5–13 Aug. 1905, show that a substantial and probably lasting interest in this latest linguistic enterprise now exists in several of the larger European countries.

In 1887 Dr. Zamenhof, a Russian physician, issued his first pamphlet concerning a suggested new international language to be called "Esperanto." Only trifling progress was made during the first ten years of the movement. The idea first took root in the originator's native country. Russian educators and other men of culture looked upon the innovation with favor. After the lapse of a decade, a start was made to introduce the Zamenhof idea among the Norwegians and Swedes. They, too, showed a friendly attitude. Then France became interested, and the famous linguist, M. de Beaufront, who had himself previously devised a plan along similar lines, threw his own scheme aside and accepted that of Dr. Zamenhof as being better fitted for the purpose intended. The result of this vigorous and decisive movement in France by so distinguished a man as M. de Beaufront was that France almost immediately became prominent as a stronghold of Esperantism.

From France the movement extended to Germany, thence to Austria, Switzerland, Italy and England. In the latter country 30 societies of Esperantists were organized within a year of the system's introduction. During the past few months, active missionary work has been undertaken in the United States, looking toward the promulgation of the Zamenhof plan for use in commercial, educational and other fields. There is little doubt as to the success of the outcome, indorsed as it is by some of the greatest philologists in Germany, Austria, England and France.

Advocates of an international language have in the past, included numerous philosophers and scientists, including Roger Bacon, Descartes, Pascal, Leibnitz, Locke, Condillac, Voltaire, and Diderot. Only of late years have the linguistic theories of these famous thinkers been moulded into anything like practical shape.

Occasions Calling for the Use of an International Language.— One of the principal reasons for renewal of interest in the direction of one universal language is the necessity for producing a vehicle of common expression among delegates representing various countries at congresses and on similar occasions. It has been found difficult for individuals, acting for their respective nations, to keep in touch with the proceedings from day to day. The extended use of Esperanto and the widespread appreciation manifested in its development indicate that the method of Dr. Zamenhof offers a feasible solution of what has, hitherto, been an unsolved problem.

In addition to the advantages of having a common language for cosmopolitan assemblages, the transaction of voluminous mercantile affairs between nations and merchants of various nations require some such system to facilitate the making of purchases and adjustment of mercantile accounts.

For educational purposes, as in other ways, the availability of a means whereby educators can compare systems and processes without encountering the difficulties connected with proper and complete translation is very evident.

Present Uses of the Esperanto Language.— From a recently-published review it is learned that books on the Esperanto language are now being printed in more than twenty languages. The number of periodicals, including those strictly scientific, printed in the Esperanto language, is estimated at twenty-five. On the continent of Europe, representative daily and weekly newspapers, occasionally or regularly, publish articles in Esperanto. Esperantist clubs and societies are operating in many European cities and have large membership. Among the most important are those of Paris, with 3,000 members, Marseilles, Lyons, Bordeaux, Havre and Lille.

Several French publishers have undertaken, in an extensive way, to publish Esperanto works, conditional on the possession of exclusive rights. Quite a number of large commercial concerns are using the system for cable and telegraphic purposes. Courses of study in Esperanto form an attractive feature in commercial schools, clubs and public institutions, some of which make a special feature of teaching the blind to read by the new system. An Esperanto typewriting machine is one of the latest developments, and in that connection many stenographers are learning the use of the language for shorthand purposes.

In the colleges and schools, Esperanto is commanding considerable attention. One of the greatest Esperantist triumphs was the recent delivery of an address in the Esperanto language by Mr. Moch, the famous peace advocate, at the International Peace Congress, Luzerne. At the Boulogne congress, 1,200 delegates from 22 countries spoke the Esperanto language freely and understood each other thoroughly. A complete test was made by means of speeches, discussions, concerts, dramatic performances and religious services.

During the congress, the work of Dr. Zamenhof was officially noticed by the French government. The Minister of Public Instruction extended thanks in behalf of the President of the Republic and of the people of France. In the course of the proceedings a reception was tendered to the creator of Esperanto at the Hotel de Ville, Paris.

Method of the Esperanto Language.— In the general plan of Dr. Zamenhof the aim is to omit all accidental words in the language of each nation, retaining only such words as are common to all nations. Sounds peculiar to any one language are eliminated. The English *th* and *w*, appearing in English words, but not in those of the French or German languages, are, therefore, according to the rule of the originator of Esperanto, dropped. The French *u*, the German *u*, and the French nasals, not used in English, are left out, also the Spanish *n* and *j*, and the German *th*. The pursuance of this plan removes all difficulties as to pronunciation.

Phonetic spelling is the Esperanto rule, a certain letter having the same sound always. Mute and double letters are cut out. The letter *x* becomes *ks*, *ph* becomes *f*, *ch* becomes *k* for the guttural sound, and *ĉ*, *c* remaining for the ordinary sound in words like cigar. The *g* is used only for the guttural (gril, garb), and *ĝ* is used for the sibilant *aĝ* which is equal to *age*. New signs introduced are *ĉ* and *ĝ*. But these are for sounds already recognized. A third sign takes the place of a double letter, viz., *ŝ* for *sh* (*ŝip* equals ship and *ŝi* equals she). Further details regarding the vocabulary, prefixes and suffixes — in fact, the whole grammar — have been issued in separate form and can be readily obtained by students. It will suffice to say here that the Esperanto vocabulary is much smaller than that of any other language, being only about 2,000 words, exclusive of scientific and technical words, as compared with 32,000 in the French language, a considerably larger number in the German language, and over 100,000 in English. The simplicity of the Esperanto grammar is quite remarkable. The majority of those who undertake the study of Esperanto, diligently, under proper instruction, master it in a short time. See UNIVERSAL LANGUAGE; SCIENCE OF LANGUAGE; etc.

Espinas, Alfred Victor, äl-frā vēk-tōr ā-spē-nä, French sociologist: b. St. Florentin, Yonne, France, 23 May 1844. After teaching philosophy in the lycées of Bastia, Chaumont, Havre, and Dijon, he became successively professor of philosophy in the universities of Douai, Lille, and Bordeaux, and in the latter was dean of the faculty of letters 1887–90. Since 1894 he has been professor of the history of social economy, on the Chambrun foundation, in the faculty of letters of the University of Paris. Besides contributing largely to the 'Revue Philosophique,' he has translated (with Ribot) Herbert Spencer's 'Psychology' (1874), and written: 'Des Sociétés Animales' (1877–8); 'La Philosophie Expérimentale en Italie' (1880); 'Histoire des Doctrines Economiques' (1893); 'Les Origines de la Technologie' (1897); 'La Philosophie Sociale du XVIIIe Siècle et la Révolution' (1898).

Espirito-Santo, ĕs-pē'rē too-sän'tō, Brazil, a state bounded on the north by the state of Bahia, on the east by the Atlantic Ocean, on the south and west by the states of Rio de Janeiro and Minas Geraes. Area 17,307 square miles. Near the capital, Victoria, and the former capital, Villa Velha, are the small mountains Penha, Moreno, Frade Leonardo, and Mestre Alvares: the highest of these, Mestre Alvares, is one of the most conspicuous landmarks on the Brazilian coast. The state has immense forests, and is noted for the valuable woods found in them. The Doce River flows through some of the richest of the hinterlands, but is navigable only for very small craft. São Matheus, in the northern part of the state, is surrounded by coffee and mandioca plantations, the products of which are shipped from this port, officially known as Conceição da Barra. A number of small ports intervene between the Doce River and the spacious bay of Espirito-Santo, which has given its name to the state. Coffee, the chief agricultural product, is largely exported. Other exports are: tapioca, mandioca, cotton, cacao, hides and skins, and woods. A railway is being built to connect Ouro Preto, on the upper waters of the Doce, with the coast. Cotton goods are manufactured in the town of Pessanha. The population of the state, which was 135,997 in 1890, has increased to 382,137, this growth being due to European immigration. A few years ago the city of Victoria (pop. 8,000 in 1890, but 20,000 in 1901) had almost no maritime trade, as its port was too shallow to admit large vessels. Recently improvements have been made in the harbor, which now accommodates transatlantic steamers, and both trade and immigrants have sought it. Colonies of Germans, Poles, Swedes, Tyrolese, Portuguese, and Italians are established near Anchieta, Alfredo Chaves, Itapemirim, and Cachoeiro — chiefly in the southern part of the state. Some of these colonies are under government protection, receiving annual subsidies of seeds and cattle, but the majority of the colonists already own lands which they work without government aid.

Esplanade, ĕs-plä-näd', in fortification, the wide open space left between a citadel and the nearest houses of the city, to prevent an enemy from being able to assail it under cover of these houses. The term is also frequently applied to a kind of terrace, especially along the seaside, for public walks or drives.

Espou'sal (Sponsalia), or **Betrothal**, in the Roman Catholic Church consists of a deliberate mutual promise of marriage, expressed by outward signs, between two persons, both of whom may lawfully and validly enter into such an engagement. When such promise is made and accepted on both sides, neither party can lawfully withdraw from it without the other's consent or unless something occurs or some circumstance comes to light which, had it been known in time, would have hindered the engagement. Formerly such engagements used to be made with some solemnity *coram ecclesia* or at least in presence of witnesses; now they are usually made without ceremony or publicity.

Espronceda, José de, hō-sā' dā ĕs-prŏn-thā'dā, Spanish poet: b. Almendralejo in Estremadura 1810; d. 23 May 1842. A precocious poet and revolutionist, he wrote the epic fragment 'Palayo' in confinement, and was repeatedly exiled. His most notable poems are: 'The Pirate'; 'The Beggar,' preaching socialism; 'The Headsman'; the grewsome 'Student of Salamanca'; 'The Clean Demon' (1841). The volume 'Forgotten Pages' was issued in 1874.

Es'py, James Pollard, American meteorologist: b. Washington County, Pa., 9 May 1785; d. Cincinnati 24 Jan. 1860. He was graduated at Transylvania University 1808. The name "storm-king" was given to him for his originating a theory of storms which involved him in much controversy. This he embodied systematically in his 'Philosophy of Storms' (1841). His meteorological doctrine on the point of how atmospheric disturbances commence was approved by the French Academy, but his views as to the mechanics of storm are contrary to received fact, and have been exploded. His principal contribution to practical meteorology was his institution of a system of telegraphic weather bulletins, which should converge at the capital and give daily intelligence of the weather in different widely separated points, and it may be justly claimed that he thus laid the foundation of all sound theory on the subject of weather prediction.

Esquimalt, ĕs-kwī'mălt, **Canada**, seaport in British Columbia, on the southeast coast of Vancouver Island, and on the Strait of San Juan de Fuca; four miles from Victoria. The harbor is extensive and capable of receiving vessels of the greatest size, and is the British naval station for this part of the Pacific coast. It has a navy yard, marine hospital, a large dry dock built by the Dominion government in 1888, and a meteorological station. In 1894 the British government started work on the defenses of Esquimalt, consisting of earthworks, with disappearing guns, and two parapet forts on the hills for protection against a possible attack by land. The harbors of both Esquimalt and Victoria are kept thoroughly mined and wired, and constitute one of the best defended naval stations in the world. The population, exclusive of the British soldiers, officials and some of their families, is small, estimated about 2,000.

Esquimaux. See Eskimos.

Esquire, originally, a shield-bearer or armor-bearer, an attendant on a knight; hence, in modern times a title of dignity next in degree below a knight. In Great Britain this title is given properly to the younger sons of noblemen, to officers of the king's courts, and of the household, to counselors at law, justices of the peace while in commission, sheriffs, gentlemen who have held commissions in the army and navy, and in fact to anyone save tradesmen, mechanics, and peasants. It is usually given to all professional and literary men, both there and in the United States. In heraldry the helmet of an esquire is represented sideways with the visor closed.

Esquirol, Jean Etienne Dominique, zhŏn ā-tē-ĕn dō-mē-nēk ĕs-kē-rōl, French physician: b. Toulouse 4 Jan. 1772; d. 12 Dec. 1840. His life was chiefly given to improving the methods of treating the insane, and he contributed greatly toward the abolition of the barbarous methods so long in vogue. In 1799 he founded a model asylum at Paris; visited all the asylums in France 1808; was appointed physician to the Saltpêtrière 1811; and in 1826 became head of the private asylum at Charenton, which he had largely planned. In 1817 his public revelations of the abuses current in French asylums led the government to appoint an investigating commission. His studies included the architecture and construction of asylums, and the best of the earlier 19th century buildings for the insane in France, such as those at Rouen, Nantes, and Montpellier, were built in accordance with his plans and instructions. He wrote: 'Des Illusions chez les Aliénes' (1832; Eng. tr. 1833); 'Des Maladies Mentales' (1838); and articles in 'Dictionnaire des Sciences Médicales,' and 'Encyclopédie des Gens du Monde.'

Esquiros, Henri François Alphonse, ŏñ-rē frăñ-swä äl-fōns ĕs-kē-rōs, French poet and miscellaneous writer: b. Paris 23 May 1814; d. Versailles 12 May 1876. His first work, a volume of poetry, 'Les Hirondelles,' appeared in 1834. This was followed by numerous romances, and a socialistic commentary on the life of Christ; 'L'Evangile du Peuple' (1840), for which he was prosecuted and imprisoned. He then published: 'Les Chants d'un Prisonnier' (1841), poems written in prison; 'Les Vierges Folles' (1842); 'Les Vierges Sages' (1842); 'L'Histoire des Montagnards' (1847); etc. Having to leave France in 1851, he resided for years in England, and wrote a series of essays for the 'Revue des Deux Mondes' on English life and character, which were translated under the title of 'The English at Home,' and were very popular. He also wrote a similar work on the Dutch. Other works of his are: 'Le Droit au Travail' (1849); 'Histoire des Martyrs de la Liberté' (1851); 'La Morale Universelle' (1859); 'Les Paysans' (1877); 'Le Château Enchanté' (1877), a novel.

Esquivel, Juan de, hoo-ăn' dā ĕs-kē-vĕl, Spanish soldier: b. 1470; d. 1519. He was the companion of Ovando when the latter went to Hispaniola to succeed Bobadilla as governor. In 1509 he conquered the island of Jamaica and settled it as a Spanish possession. The colony flourished under his administration, and he founded there the city of Sevilla Nueva.

Ess, Johann Heinrich van, yō-hān hĭn'rĭʜ fān ĕs (better known by his Benedictine name "LEANDER"), German theologian: b. Warburg 15 Feb. 1772; d. Affolderbach in the Odenwald 13 Oct. 1847. He entered the Benedictine abbey of Marienmuster as a novice 1790; was pastor at Schwalenberg 1799–1812; and professor of theology at the seminary in Marburg 1812–22. In 1807, with his cousin Karl, he published a German translation of the New Testament, the circulation of which was forbidden by the Pope. The following year he published a defense of his views as to Bible reading by the people, a new edition of which was issued in 1816 entitled 'Gedanken über Bibel und Bibellehre.' After 1822 he gave his whole time to circulating his Bible versions among the people, to spreading his doctrines, and to the composition of a German version of the entire Scriptures, which he finished in 1840. Others of his publications are: 'Was War die Bibel den Ersten Christen?' (1816); 'Die Bibel Nicht ein Buch für Priester' (1818); an edition of the Vulgate (Tübingen 1822–4); of the Septuagint (1824; new ed. 1887); and of the Greek New Testament (1827).

Essay, a composition in which something is attempted to be briefly proved or illustrated. It is not easy to define the limits of the essay as a species of composition. In general it is understood of the briefer and less elaborate efforts of literary skill; but this distinction is not always maintained. Caution or modesty has induced many writers of note to give the title of essay to their most elaborate productions; thus we have Locke's 'Essay on the Human Understanding.' The subject of an essay may be any topic of human interest; it may be philosophical, scientific, logical, ethical, æsthetical, or humorous; and a series of essays may embrace connected, but so far independent views of the most extensive range of subjects. There is a class of English writers to whom the descriptive term essayist is applied. 'The Spectator,' 'The Tatler,' 'The Rambler,' and many other extensive collections, are among the works of this class of writers, the best of whom, from the variety which their works present in other particulars, can only be distinguished by excellence of style. In the United States Emerson is the most favorably known among essayists. From the brevity of the essay, considered in its ordinary sense, and the necessity of giving it some specific claim on the attention of cultivated readers, style may possibly be considered to have been, at least until recently, the distinctive characteristic of essay writers, and this form of composition may be supposed to have done some service in maintaining the standard of purity and excellence in the English language. See ENGLISH LITERATURE.

Essay on Criticism, An, a didactic poem by Pope (1711) in which he brilliantly explained and propounded the canons of verse structure and poetic taste. The poem abounds in striking passages which have become familiar quotations. See POPE, ALEXANDER.

Essay on Man, An, a famous philosophical poem by Alexander Pope (q.v.), which appeared in four parts, 1732 to 1734. It was imitated by Voltaire and others. It contains many expressions which have become proverbial.

Essay on the Human Understanding, a famous philosophical work by John Locke (q.v.) (1690).

Es'sen, Germany, town of Rhenish Prussia, 18 miles northeast of Düsseldorf. It has recently greatly increased in population and manufactories. It is celebrated for the steel and iron works of the Krupps, the most extensive in Europe, employing about 28,000 workmen. This great establishment was started in 1827, with only two workmen. The rifled steel cannon made here are supplied to most of the armies of Europe. In the suburbs are the "colonies" — cottages, churches, schools, stores, libraries, places of amusement, homes for superannuated and disabled workmen, etc., established by the Krupps for their workmen. The town was founded in the 9th century, when the Benedictine abbey was established here, and for some time it was under the control of the Abbess of Essen. In the 10th century the Abbess Hagona gave the town municipal privileges.

Essence, in metaphysics, originally the same as substance. Later, substance came to be used for the undetermined substratum of a thing, essence for the qualities expressed in the definition of a thing; or, as Locke put it, «Essence may be taken for the very being of a thing, whereby it is what it is.» In chemistry, and in popular parlance, essences are solutions of the essential oils in alcohol, and may be prepared by adding rectified spirit to the odoriferous parts of plants, or to the essential oils, and distilling; or simply by adding the essential oil to the rectified spirit, and agitating till a uniform mixture is obtained. The term has, however, received a wider significance, and is applied to any liquid possessing the properties of the substance of which it professes to be the essence. Thus essences of coffee and beef, and rennet contain in a concentrated form the virtues of coffee, and beef, and in some circumstances may be substituted for them.

Essenes, ĕs-sēnz′ (Εσσηνοι, Ἐσσαιοι, *Esseni*), a sect or society of Hyper-Pharisaic Jews which was already in existence 150 years B.C., and which existed till the 4th century; the remnant then returning to Pharisaic or orthodox Judaism or entering the Christian communion. Josephus the historian (1st century) describes their manner of life in some detail; Philo Judacus has a notice of it, so too has Pliny in his ‘Historia Naturalis.’ Josephus was in his youth a probationer of the society, but lived among them only a short time and was unacquainted with the details of their system, which were strictly withheld from novices; but his narrative has the marks of authenticity. In essentials Josephus and Philo are in accord, and with them agrees Pliny in the one peculiarity of this society which he notices — their celibate life. The Essenes were stern ascetics and in that respect were the prototype of the Christian Solitaries, who in the 3d and 4th centuries peopled the Nubian deserts: withal, they were both in name and in deed Friends — for such was one of the appellations of the brethren. Among themselves they had all things in common, like the first Christians, and they were open-handed and hospitable to strangers. There were groups of Essenes in all the towns of Judea, but their institute had opportunity for full development only in their communal settlements on the western shore of the Dead Sea, where they devoted themselves to their peculiar religious observances and to agriculture and a few simple handicrafts. Their food was of the simplest, taken at the common board, their only drink, water; their attire was of the plainest, white linen material. None possessed more than one tunic or more than one pair of shoes. They rose at daybreak for prayer; after prayer and a hymn they went about their customary occupations. (Here we are reminded of what Pliny wrote to Hadrian concerning usages of the Christians in Bithynia: «They met on a stated day before daybreak and chanted a hymn to Christ as God.») At the 5th hour (11 A.M.) they again assembled in one place and bathed their faces in cold water, after which they put on pure white garments and repaired to the common simple meal, which was preceded by a blessing, a prayer and a hymn; and after the repast there was again prayer and a hymn. Then the brethren put off the ceremonial garb of white linen, put on their workday attire, and went back to their employments. No women were admitted to the order; like some of the modern Shakers they adopted young boys and brought them up in their own simple way of living; on attaining maturity they might, if willing, be admitted to membership after a term of probation; or they were free to return to the world. But they also received accessions of life-weary grown people. «Thus,» says Pliny, «here is a people that never dies out (*æterna est*) yet in which there are no births: so fruitful for them is others' ‘disgust of life’» (*Tam foccunda illis aliorum vitæ pœnitentia est*). Like the Society of Friends they forbade oaths; and they held that a man whose word needed to be confirmed by oath was not to be believed at all. Nevertheless the postulant for admission into the society was required to take «terrible oaths» that he would pay worship to God, be just to men, injure none, hate the unjust, be faithful and true to all, especially rulers, for none bears rule save by God's will. Pliny writes of a similar oath taken by the Christians.

There were four degrees of membership resembling in some respects the castes of the Hindus. If a person in a higher degree so much as touched one of a lower grade, he was thereby defiled and was bound to make himself clean in cold water. Their severely abstemious life, their contempt for riches and honors, their deep conviction of the immense superiority of their religion gave them all the heroic courage in face of persecution and torture which distinguished the Christians in the ages of martyrdom. So scrupulous were they in avoiding everything like idolatry, that some of them would never enter any city because of the images erected at the gates; nor would they touch a coin that bore the likeness of any ruler.

Consult: Pliny, ‘Historia Naturalis’; the writings of Josephus and Philo Judacus; also *Philosophumena*, or ‘Refutation of all Heresies,’ written in Greek 230 A.D., author unknown.

Essential Oils. See OILS.

Essequibo, ĕs-sĕ-kē′bō, a river of British Guiana, which flows into the Atlantic by an estuary 20 miles in width. Its course is very irregular; its whole length is about 600 miles. It is navigable for some distance from the ocean. The district or division of Essequibo, which is in the basin of the Essequibo River, is well cultivated and extremely fertile, producing coffee, cotton, cocoa, and sugar. A portion of the basin of this river was included in the disputed territory claimed by the Venezuelan and the British governments in 1896. The claims were settled by treaty 2 Feb. 1897. Pop. 36,000.

Essex, Robert Devereux, 2D EARL OF, English courtier: b. Netherwood, Herefordshire, 10 Nov. 1567; d. London 26 Feb. 1601. He was educated at Trinity College, Cambridge, and appeared at court in 1577. On Leicester's death 1588, he became the chief favorite of Elizabeth. In 1590 he married the widow of Sir Philip Sidney, and in 1591 was sent to support Henry IV. against Spain, but the expedition effected nothing of importance. About this time Essex was on terms of close friendship with Francis Bacon, who assisted him greatly by advice on political and other matters. In 1596 he commanded an expedition to Spain, and greatly distinguished himself at the capture of Cadiz.

In 1597, after an unsuccessful expedition to the Azores, he, with Howard and Raleigh, made extensive captures of Spanish ships. Next year he quarreled with the queen, who struck him on the ear and bade him "go and be hanged." After some months a reconciliation took place, and he was appointed lord-lieutenant of Ireland (1599), then in a state of rebellion. He returned to England in September, having been entirely unsuccessful in his government; was made a prisoner in his own house, and was shortly afterward (June 1600) tried by a special court. The charges against him were that he had exceeded his instructions in the Irish campaign, and had deserted his post without leave; and he was deprived of all his offices, and sentenced to imprisonment, but not long afterward was set at liberty. He now conceived a deep resentment against the queen's councilors, particularly Cecil and Raleigh, who, he imagined, had biased her against him. Being summoned before the council, he assembled his friends in his house, and proceeding to the city, endeavored to enlist the citizens in his favor. After a skirmish with a party of soldiers he returned to his house, but after a short defense was compelled to surrender, and sent to the Tower. He was tried for treason on 19 February, and executed on 26 Feb. 1601. See Spedding, 'Bacon' (1881); Abbott, 'Bacon and Essex' (1877).

Essex, Robert Devereux, 3D EARL OF, English soldier: b. 1591; d. 14 Sept. 1646. When 11 years old he was restored by James I. to the rank and titles held by his father, the 2d earl. He served in the army of the elector palatine in Holland 1620–3, was vice-admiral of an unsuccessful naval expedition against Cadiz in 1625, and lieutenant-general of an army sent by King Charles against the Scotch Covenanters in 1639. Espousing the cause of the Parliament against the king, he was appointed to the command of the parliamentary army at the beginning of the civil war, was victorious over Charles at Edgehill in 1642, captured Reading in 1643, and relieved Gloucester, but lost the greater part of his army in 1644. He urged the impeachment of Cromwell before the House of Lords in 1645, and had to resign his commission. An annuity of £10,000 was settled on him for life.

Essex, England, a maritime county, on the southeastern coast; area, 1,533 square miles, of which 80 per cent is under cultivation. The chief towns are Chelmsford, the county town; Colchester, Maldon, and Harwich. Pop. about 1,087,000.

Essex, The, an American 32-gun frigate built 1799 for the war with France. She was used as a Pacific convoy, and served later in the wars with the Barbary pirates. In 1812 Capt. David Porter did effective work with her: cutting out a brig with 197 soldiers from a British transport fleet; forcing the 16-gun sloop Alert to strike in eight minutes; and in a cruise on the west coast of South America, capturing the entire British whaling fleet and other prizes, they and those destroyed aggregating $2,500,000 in value. In February 1814 two British vessels, the 36-gun Phœbe and the 18-gun Cherub, blockaded her in the neutral harbor of Valparaiso; on 28 March he attempted an escape, but the vessel was disabled by a sudden gale, and in a fight of 2 hours and 20 minutes was cut to pieces, losing 58 killed and 66 wounded out of 255, and being left in a sinking condition. The battle was a mere massacre: the British had 38 long guns to the Americans' 6.

Essex Junto, a name applied about 1781 by John Hancock to the group of Massachusetts political leaders resident in or connected with Essex County, Mass.— the northeastern county, from just north of Boston to the New Hampshire boundary. Its coast was a line of commercial and fishing towns, and its interests therefore overwhelmingly in favor of a strong national government to protect them from foreign countries and their sister States. This made its leaders, whose great ability gave them powerful influence, the vanguard of the ultra Federalists, and adherents of Hamilton, whom they followed in his split with John Adams. The latter revived the old nickname, charged them with being a "British faction" and forcing on a war with France, and for years after his retirement assailed them in the press. When the embargo (q.v.) and the later war solidified all New England Federalism in a common self-defense, all the opposition and the suspected treason were attributed by outsiders to the Essex Junto. Its chief members were George Cabot, Timothy Pickering, Theophilus Parsons (State chief justice), the Lowell family, Stephen Higginson, and Benjamin Goodhue.

Esslingen, ĕs'ling-ĕn, Germany, town in Würtemberg; on the Neckar, seven miles east-southeast of Stuttgart. It was founded in the 8th century and was long a fortified, imperial free town. The old church, monastery, and town house are still extant. Originally Esslingen belonged to the duchy of Swabia, and the Swabian League of Swabian cities and governments was formed here in 1488. There are manufactories for machinery, articles of wood, gold, silver, and tin, and also for cutlery, dye-works, and paper.

Essonite, or **Hessonite,** a variety of garnet (q.v.), also often called Cinnamon-stone (q.v.).

Estaing, ĕs-tăṅ, **Charles Hector,** COMTE D', French army and navy officer: b. Auvergne 1729; d. Paris 28 April 1794. He entered the French army as colonel of infantry; was promoted brigadier-general in 1757, and in 1777 became vice-admiral in the French navy. In 1778, in accordance with the treaty between France and the United States, France fitted out a fleet of 12 ships of the line and 4 frigates to aid the latter in the struggle against Great Britain, and Estaing was placed in command. He sailed 13 April, reached Delaware Bay in July, and proceeded to New York. He captured some prizes off the coast of New Jersey, agreed to assist in a land and sea attack on Newport to expel the British from Rhode Island; reached the harbor late in July; and hearing of the approach of a fleet, put to sea to meet it. He was overtaken by a severe storm, which caused him to put into Boston for repairs, and the projected attack failed. Subsequently he captured St. Vincent and Grenada, West Indies, and in 1779 co-operated with Gen. Lincoln in an ineffectual attempt to capture Savannah, Ga. He returned to France in 1780; commanded the allied fleets of France and Spain in 1783; was chosen admiral of the navy in 1792; and, despite his eminent military and naval services to

France, was condemned as a royalist and guillotined in 1794.

Estancia, ĕs-tän'thē-ä, Philippines, a pueblo of the province of Iloilo, situated on the eastern coast of the island of Panay, 66 miles north of the town of Iloilo. The main portion of Estancia is one mile inland, connected by a good road with the coast and anchorage ground. Pop. 12,700.

Estate, a term sometimes used to indicate property generally, whether personal or real. Sometimes it includes land alone. It signifies in law the interest which a person may have in property. It denotes the time during which ownership may exist, as for a year, for life, or forever. At common-law estates in land are divided, as regards the quantity of interest, into two kinds, (1) freehold estates, and (2) estates less than freehold. A freehold is an estate which may last for life or longer. An estate which is circumscribed within a certain number of years, or one in which the possessor has no fixed right of enjoyment, is less than freehold, and although in fact it may last longer than the life of its first possessor, still the law regards it as a lower estate than a freehold; it is personal property in the eye of the law, and does not descend to heirs, although it may pass to executors or administrators.

Freehold estates are divided into estates of inheritance, which pass to heirs, and estates not of inheritance; the former are again divided into estates in fee simple and estates in fee tail. An estate in fee simple is the estate which a man has where lands are given to him and his heirs absolutely without any end or limit put to his estate, and it is the most extensive and the highest interest a man can have in land. If not aliened or devised, it passes to heirs generally. On the other hand, a fee tail is an estate which is limited to certain particular heirs or to a certain class of heirs, to the exclusion of the others; as to the heirs of one's body, which excludes collateral heirs, or to the heirs male of one's body, which excludes females.

In the United States fee tails have had only a limited existence, and are now in general abolished. They were changed into estates in fee simple in New York as early as 1782. Freeholds not of inheritance are for life only, either for the life of the tenant or of some other person or persons; when the estate is called an estate *pour autre vie.* Life estates are created by operation of law, or by the act of the parties. An example of an estate created by act of the parties is where A conveys land to B for the term of his natural life, or where A conveys land to B without mentioning the duration of the term. Here under the common law B would take only a life estate; but by statute in many of the States — among them New York — a grant or devise of real estate possesses all of the interest of the grantor or testator, unless the intent to pass a less estate or interest appears by express terms or by necessary implication.

Dower and courtesy are estates created by operation of law. An estate by the courtesy is that estate to which a husband is entitled upon the death of his wife in the lands or tenements of which she was seized in possession in fee simple or fee tail, during their coverture, provided they have had lawful issue born alive, and possibly capable of inheriting her estate. An estate in dower is an estate which a widow has for her life in some portion of the lands of which her husband was seized at any time during coverture, and which her issue might have inherited if she had any, and which is to take effect in possession from the death of her husband.

Estates less than freehold are divided into estates for years, at will and by sufferance. An estate for years is an interest in lands by virtue of a contract for the possession of them for a definite and limited period of time. Such estates are ordinarily called terms. The length of time for which the estate is to endure is of no importance in ascertaining its character, unless otherwise declared by statute. An estate at will is where one man lets land to another to hold at his will, as well as that of the lessee. An estate of this kind is terminated by either party on notice. Out of estates at will a class of estates has grown up called estates from year to year, which can be terminated only by six months' notice, expiring at the end of the year. An important element in creating this estate is the payment of rent. An estate at sufferance is the interest of a tenant who has come rightfully into possession of lands by permission of the owner, and continues to occupy the same after the period for which he is entitled to hold by such permission. This estate is not of frequent occurrence, but is recognized as so far an estate that the landlord must enter before he can bring ejectment against the tenant. If the tenant has personally left the house, the landlord may break in the doors, and the modern rule seems to be that the landlord may use force to regain possession, subject only to indictment if any injury is committed against the public peace.

Estates may depend upon condition; that is, their existence may depend on the happening or not happening of some event whereby the estate may be created, enlarged, or defeated. A term for years, a freehold, or a fee may thus be upon condition. The condition must either be precedent, that is, must happen before the estate can vest or be enlarged; or must be subsequent, when it will defeat an estate already vested.

Estates may also be divided into estates which are legal and those which are equitable. Estates are termed equitable when the formal ownership is in one person, while the beneficial ownership is in another. In another form of expression it may be said that a trust is created. The nature of the estate is not affected by this distinction. For example, a trust estate may be an estate for life or a fee, and in the latter case is transmissible to heirs as though it were a legal estate.

Estates are divided into estates in possession and estates in expectancy, in regard to the time of enjoyment. An estate in possession is one in which there is a present right of enjoyment. Estates in expectancy are those which give either a vested or contingent right of future enjoyment. Estates are also divided, in regard to the number of owners, into estates in severalty; in joint tenancy, in common and in coparcenary. An estate in severalty is one which has only a single owner. An estate in joint tenancy is an estate owned jointly by two or more persons, whose title is created by the same instrument. The right of survivorship is the distinguishing characteristic. When a tenant dies his interest is extinguished, and the estate goes to the survivors. Where an estate is conveyed to two or more persons, at common law, without indicating how it is to be held, it is construed to be in joint tenancy. In most of the United States, however, this rule has been changed by statute, and persons to whom an estate is conveyed or given take as tenants in common, unless they hold as trustees. An estate in common is an estate held in joint possession by two or more owners at the same time by several and distinct titles. An estate in coparcenary is an estate which several persons hold as one heir, whether male or female. This estate has the three unities of time, title, and possession. The interests, however, of the coparceners may be unequal. In the United States this estate is essentially extinguished, and heirs take as tenants in common.

Este, ĕs-tā, the name of an illustrious and ancient Italian family. Albert Azzo II. is considered the founder of the greatness of his house. He inherited or acquired Este, Rovigo, Montagnana, Casal Maggiore, and other places in Italy; and was made governor of Milan by Henry III. in 1045. One of his sons became duke of Bavaria in 1071, by the title of Welf I. He was the ancestor of the German branch of the house of Este, the dukes of Brunswick and Hanover. Albert Azzo died 1097, having previously resigned his Italian possessions to his son Fulk, and retired to Burgundy. Fulk I. was attacked by his brother Welf, who compelled him to become tributary to him to the extent of a third of his revenues. He was succeeded (1137) by his son, Obizzo I., who joined the Lombard league against Frederick Barbarossa in 1167. He d. 1193, and was succeeded by his son, who in the annals of the family is called Azzo V. Either he or Oberto acquired by marriage Ferrara, with its dependencies in Romagna, and with a feud which became hereditary with the house of Torello, for a member of which house the bride, violently carried away by the Estes, was intended. The house of Este thus became vassals of the Church as well as of the empire. He was succeeded by Azzo VI. (d. 1212). He was constantly engaged in war with the Torelli, by whom he was thrice driven from Ferrara. Aldobrandino, his son, died young, and was succeeded by his brother Azzo VII., a minor, in 1215. He was engaged in protracted wars with the Ghibelline party. Honorius VII. invested him with the marquisate of Ancona. He d. 1264, and was succeeded by his grandson, Obizzo II., who was chosen Lord of Modena and Reggio. We may pass over his successors to Niccolo III., who succeeded in 1393 at the age of nine. During his reign, and those of some of his predecessors, the house of Este became patrons of literature. He died at Milan 26 Dec. 1441. Lionel, his son (1441–50), receives a high character from Muratori for justice and piety, and for his patronage of letters. He mediated a peace in 1450 between the Venetians and Alfonso, king of Sicily; and died in November of the same year. He was succeeded by his brother, Borso (d. 20 Aug. 1471), who received new accessions of dignity from the emperor, and was created Duke of Ferrara by Pope Paul II. His reign was peaceable and prosperous. Ercole I., his brother (d. 25 Jan. 1505), succeeded, to the prejudice of his son Niccolo. His usurpation caused a war, which was unsuccessful in deposing him. He had Milan and Florence for allies, the Pope and Venice for adversaries. After the conclusion of peace in 1484 he maintained neutrality in his estates for the remainder of his reign, while the rest of Italy was convulsed with wars and revolutions. He had for his minister Boiardo, the famous author of the 'Orlando Innamorato'; and Ariosto, born near the commencement of his reign, grew up under his patronage. Alfonso I., his son, d. 31 Oct. 1534. His reign was a contrast to the peaceable one of his father. In 1509 he joined the League of Cambray, and commanded the Papal army as gonfalonier. While conducting the operations of the allies elsewhere, his estates were ravaged by the mercenary troops of Venice, whose atrocities are described in the 36th canto of the 'Orlando Furioso.' Alfonso continued in the French alliance after the Pope had joined the Venetians. He assisted in the battle of Ravenna, and took prisoner Fabrizio Colonna, the general of the Pope. After the French had been driven from Italy he endeavored to make peace with the Pope; but Julius continued implacable. Leo X. restored him to his possessions, with the exception of Modena and Reggio, but afterward excommunicated him. He joined in the wars between Francis I. and Charles V. on the side of the French king, but was afterward reconciled with the emperor, who confirmed him in his possessions, against Pope Clement VII. (1530). He married as his second wife the famous Lucrezia Borgia. His brother, the Cardinal Ippolito, was the patron of Ariosto. Alfonso was succeeded by his son, Ercole II., who died 3 Oct. 1559. He married Renée of France (daughter of Louis XII.) in 1528. She favored the Reformation, and made the court of Ferrara the resort of the few advocates of that cause in Italy. Calvin visited it in 1535. Ercole at first adhered to the imperial party, but in 1556 joined the league of Paul IV. and Henry II. of France against Spain, and was made general of the allied forces; but did not push the war with vigor, and made peace with Spain in 1558. Leonora, his daughter by Renée, was the object of the unfortunate attachment of Tasso. He was succeeded by his son, Alfonso II., the patron and persecutor of Tasso, who died 27 Oct. 1597. He was succeeded by his cousin Cesare (d. 11 Dec. 1628), whom by his testament he had made his heir; but this disposition was annulled by the Pope, Clement VIII., who excommunicated Cesare and deprived him of Ferrara, with the dependencies of the Church. Cesare was obliged to content himself with Modena and Reggio, which depended on the empire. From this period the political importance of the house of Este greatly diminishes. The last sovereign of the house was Francesco V., who succeeded in 1846. In 1859, the dynasty was deposed by the National Assembly, the duchy was annexed to Sardinia by the Treaty of Zürich 10 Nov. 1859, and has consequently been incorporated with the kingdom of Italy.

Este, Italy, a town in the province of Padua, 17 miles southwest of Padua; the ancient Adeste. Pop. about 6,000. The leaning tower, or campanile, is an interesting feature of the town, as is the battlemented mediæval fortress, known as the Rocca. Here once ruled the Este family, one of the most ancient and illustrious families of Italy. In the 11th century the house of Este became connected by marriage with the German Welfs, or Guelphs, and founded the German branch of the house of Este, the dukes of Brunswick and Hanover. The sovereigns of Ferrara and Modena were of this family, several of them being famous as patrons of letters. The lives of Boiardo, the author of ‘Orlando Innamorato’; Ariosto, and Tasso were closely connected with members of this house. The last male representative of the Estes died in 1798. His daughter married a son of the Emperor Francis I. of Austria, who founded the Austrian branch of the house of Este, of which the male line became extinct in 1875.

Esters (an arbitrary modification of «ether»), Compound Ethers, or Ethereal Salts, are compounds in which one or more alcohol or basic radicals are united to one or more acid radicals. They are analogous to the salts of the metals. Thus $CH_3COO.H$ is acetic acid, and if the typical hydrogen of this acid is replaced by the monad radical «ethyl,» the resulting compound, $CH_3COO.C_2H_5$, is known as «ethyl-acetic ester.» Chemically, this substance is analogous to potassium acetate, $CH_3COO.K$, obtained by replacing the hydrogen of the acetic acid by potassium. The word «ester» was originally applied by Gmelin to compounds of the alcoholic radicals with oxygenated acids; but it has now been extended so as to include all the salts of the alcoholic radicals. Ethyl bromide, $C_2H_5.Br$, for example, is now included among the esters. Some of the esters are prepared by the direct action of the acid upon the alcohol. In other cases a mixture of the acid and the alcohol is distilled with the addition of sulphuric acid, zinc chloride, or other dehydrating agent. The esters may also be prepared by treating the iodide of the alcohol radical with the silver salt of the acid, the iodine and silver combining to form iodide of silver, while the liberated alcoholic and acid radicals combine to produce the desired ester. The esters of the organic acids occur in fruits and flowers, and are also prepared artificially for flavoring purposes, and for improving the bouquet of wines. The fats and oils which contain glycerine in combination with oleic, margaric and other acids may be regarded as esters, since glycerine is a triatomic alcohol. Much attention has been paid to the esters in connection with theoretical chemistry, since they are well adapted for the study of the laws of mass-action. See Equilibrium, Chemical; Ether.

Es'terhazy. See Eszterhazy.

Esther, or **Hadassal** (Heb. «myrtle»), the name of a Jewish maiden, chosen by Xerxes to be his queen. She was one of the heroines of Hebrew history and maintained the rights of her nation at the court of the king of Persia. See Esther, Book of.

Esther, Apocryphal Books of. See Apocrypha.

Esther, The Book of, relates how a Jewish virgin, who was a foster-daughter of Mordecai, was chosen by the king of Persia, Ashauerus (Xerxes), as his wife in room of the disobedient and disgraced queen Vashti, and brought about the great deliverance of her people which is commemorated in the Feast of Purim («lots»). Haman, the king's prime minister, had issued a decree for the extirpation of all the Jews, and had prepared to hang Mordecai; but Mordecai, who had formerly detected a conspiracy against the king's life, was raised to great honor, and Haman was hanged on the gallows 50 cubits high that he had prepared for Mordecai. After this Esther, at Mordecai's instance, revealed her Hebrew lineage, and prevailed upon the king to counteract the former edict by another permitting the Jews everywhere to destroy their enemies. The ‘Book of Esther’ stands conspicuous among the Hebrew scriptures as an expression of the uncompromising spirit of Hebrew nationality, containing hardly a trace of religious feeling. The name of God is not once mentioned, while the great king of Persia is referred to nearly 200 times. A possible explanation is the fact that the book was meant to be read at the merry revels of the Purim festival. It has continued in constant use and favor among the Jews, and of the five Hagiographical rolls it is called emphatically ‘The Roll’ (*Megillah*). The author is quite unknown, and the date is probably the latest Persian or the earliest Greek period.

Esthonia, ĕs-thō'nĭ-ạ, Russia, a maritime government, bordering on the Gulf of Finland and the Baltic. It includes several islands, of which the most important are Dagoe and Oesel; area, about 7,818 square miles. The peasantry are almost all of Finnish origin, and speak a Finnish dialect. In the 10th and 12th centuries it belonged to Denmark; it was afterward annexed by Sweden, and in 1710 was seized by Russia. Reval is the capital. (See Reval.) Pop. 416,580. Consult: Vincent, ‘Norsk, Lapp, and Finn’; Jordan, ‘Beiträge zur Geographie und Statistik Esthlands.’

Estienne, ā-tē-ĕn, or **Etienne** (Lat. Stephanus), **Henri,** ŏṅ-rē, French painter and scholar: b. Paris 1528; d. Lyons March 1598. He was a son of Robert Estienne (q.v.) and continued his work. Beside compiling the noted ‘Thesaurus linguæ Græcæ’ (1572), he wrote ‘Apologie pour Hérodote’ (1566); ‘Traité de la conformite du Français avec le Grec’; etc.

Estienne, or **Etienne** (Lat. Stephanus), **Robert,** rō-bār, French printer and scholar: b. Paris 1503; d. Geneva 7 Sept. 1559. In 1526 he established a printing house in Paris and in 1539 was appointed royal printer to Francis I. He removed to Geneva about 1552. He published many editions of the Greek and Latin classics and compiled numerous other works. His son Henri took up his father's work on the death of the latter and was also a writer of note. He died in Lyons in 1598.

Estiva'tion, the dormancy or «summer-sleep,» induced in some of the lower plants and animals by heat and drought, and the means by which in summer they resist these unfavorable conditions, as they do others in winter by hibernation. The two states are comparable, though induced by opposite conditions. In summer the principal danger to which such organisms are exposed is the deprivation of water. Some of the lowest are able to endure this to an extreme degree. Certain bacteria and other low plants, and various animalcules will survive prolonged baking, and may blow about in the dust of dried-up ponds for a long period, ready to revive when dampened. Among land-snails estivation is a common phenomenon, the snails protecting themselves from excessive loss of moisture, not only by burrowing into the ground, but by throwing one or several epiphragms of hardened, sometimes chalky, mucus across the aperture of the shell, thus shutting themselves into an air-tight case, where they remain inactive until better conditions arrive. In a similar manner certain fishes and amphibians bury themselves in the muddy bottom of ponds or river-pools evaporated by drought, where they preserve sufficient dampness about them to keep alive. Turtles, on the other hand, are often compelled to leave their pools in the tropics, because the water becomes so hot and full of fermentation, and seek cool spots under rocks, and the like, where they sleep torpidly until autumn. Even a few mammals of extremely hot regions, such as the deserts of Australia, go into a summer-sleep during the height of the hot season, substantially as their congeners hibernate in the midwinter of northern climates. Compare: HIBERNATION.

Estop'pel, the preclusion of a person from asserting a fact by previous conduct, inconsistent therewith, on his own part or the part of those under whom he claims, or by an adjudication upon his rights which he cannot be allowed to call in question; a preclusion, in law, which prevents a man from alleging or denying a fact, in consequence of his own previous act, allegation or denial of a contrary tenor; a plea which neither admits nor denies the facts alleged by the plaintiff, but denies his right to allege them. According to Blackstone, it is a special plea in bar, which happens where a man has done some act or executed some deed which precludes him from averring anything to the contrary. Where a fact has been asserted or admitted for the purpose of influencing the conduct or deriving a benefit from another, so that it cannot be denied without a breach of good faith, the law enforces the rule of good morals as a rule of policy, and precludes the party from repudiating his representations or denying his admissions. (Rawle, Cor. 407.)

This doctrine of law gives rise to a kind of pleading that is neither by way of traverse nor of confession and avoidance; that is, a pleading which, waiving any question of fact, relies merely upon the estoppel, and, after stating the previous act, allegation, or denial of the opposite party, prays judgment if he shall be received or admitted to aver contrary to what he before said or did. This pleading is called a pleading by way of estoppel. Until a recent period questions regarding estoppel arose almost entirely in relation to transfers of real estate, and the rules in regard to one kind of estoppel were quite fully elaborated. The principle is now applied to all cases where one by words or conduct wilfully causes another to believe in the existence of a certain state of things, and induces him to act on that belief or to change his own previous situation.

Estoppels operate not only on present interests, but on rights subsequently acquired. They operate, however, only between parties and privies, and the party who pleads the estoppel must be one who was adversely affected by the act which constitutes the estoppel. An estoppel may be by record, and by record in this connection is meant the record of a tribunal of a judicial character. An admission made in a pleading in a judicial proceeding cannot be contradicted by the person making it. So, ordinarily, the judgment of a court of competent jurisdiction cannot be impeached. If it determines the status of a person or thing, it is binding on all persons, whether rendered by a domestic or a foreign court. Judgments of this character are judgments *in rem.* If the judgment is *in personam,* it is conclusive if rendered by a domestic tribunal, and is conclusive in some instances if rendered by a foreign tribunal. Legislature records also import absolute verity. (Bigelow on Estop. 33.)

An estoppel by deed is such as arises from the provisions of a deed. It is a general rule that a party to a deed is estopped to deny anything stated therein which has operated upon the other party, as the inducement to accept and act under such deed, including a deed made with covenant of warranty, which estops even as to a subsequently acquired title. The deed must be good and valid in its form and execution to create an estoppel, and must convey no title upon which the warranty can operate in case of a covenant.

Estoppels must be reciprocal. An estoppel *in pais,* or equitable estoppel, occurs when a party to an action has by his act or declaration induced the other party to do some act or acts which otherwise would not have been done, or to omit to do some act or acts which he would have done, and by means of which he has been injured. The principle underlying such estoppels is, that it would be a fraud in a party to assert what his previous conduct and admission have denied, when, on the faith of that denial, others have changed their situation. There must, however, as a rule, be some intended deception in the conduct or declarations of the party to be estopped, or such gross negligence on his part as to amount to constructive fraud, by which another has been misled to his injury.

Estotiland, a mythical land, placed by the old geographers where is now portions of Newfoundland, Labrador, and that part of British America bordering on Hudson Bay. It was said to have been discovered by two Friesland fishermen driven out of their course by a storm, two centuries before the time of Columbus. In 1497 the Cabots set sail from England for Estotiland, but discovered instead Newfoundland.

Estremadura, ĕsh-tra-mä-doo'rä, Portugal, a maritime province divided by the Tagus into two nearly equal parts, of which the north is the more mountainous. Wines and olives are the principal produce. The chief city is Lisbon. Area, 6,876 square miles.

Estremadura, ā-strä-mä-doo'rä, a division of Spain, in the southwest, consisting of two provinces, Badajoz and Caceres. The northern part has large forests, and in the central and southern parts are some good agricultural lands. Deposits of coal, copper, and silver are found in the mountains; but the mines are not well developed. Area. 16,700 square miles; pop. 845,873.

Es'tuary. Where a shore-line is sinking or has been recently depressed, the rivers, unless large and heavily charged with sediments, have their valleys drained by the encroaching sea, forming roughly funnel-shaped bays. Such bays are called estuaries, and are common along the sinking Atlantic coast of North America. Illustrations are seen in Passamaquoddy and Narragansett bays, the mouth of the Hudson River, Delaware and Chesapeake bays. Owing to their shape, estuaries frequently have strong tidal currents, due to the height of the tides, and the rising tide rushes in as waves, the most remarkable examples of such surf-like tidal waves, or bores, being found in the Bay of Fundy. The rivers entering estuaries drop much of their fine sediment there because of the checking of their currents and the precipitating effect of salt water. The strong tidal currents sweep away and rearrange these sediments. Hence conditions on the bottoms of estuaries are often unfavorable for the growth of organisms, and the estuary deposits of past ages are seldom rich in fossils, but may contain remains of land organisms brought down by the old river; and the tidal mud-flats have preserved the prints of raindrops, the traces of worms, and the tracks of birds and reptiles. See RIVER.

Eszterhazy, ās-tăr-ä-zē, or ĕs'tĕr-hä-zĭ, **Marie Charles Ferdinand Walsin,** forger: b. Austria 16 Dec. 1847. He served in a regiment of Papal Zouaves during the latter part of the French empire; was promoted commander, a rank equivalent to major in other armies, in 1892. In the early part of 1897 he was retired from the army. He became known throughout the civilized world through his connection with the trial of Capt. Alfred Dreyfus (q.v.), whom he accused as being the writer of the famous "bordereau," alleged to have been sent to certain German military officers revealing French military secrets. In December, 1894, Dreyfus was tried by court-martial and convicted as the author of the document, and on 5 Jan. 1895 was publicly degraded and a little later sent as a prisoner to Devil's Island. In 1896, Col. Picquart, the head of the intelligence bureau of the war office, made certain discoveries which pointed to Maj. Eszterhazy as the author of the "bordereau." These discoveries led to further investigation and Dreyfus was brought from his prison and given a new trial in 1899, but was again convicted, although much of the evidence gathered pointed to Eszterhazy as the forger of Dreyfus' handwriting and as the real traitor. So strong did this opinion become that Eszterhazy was compelled to leave France.

Eszterhazy von Galantha, ĕs'tĕr-hä-zĭ fōn gä-län'tä, a family of Hungarian magnates, afterward princes of the German empire, whose authentic genealogy goes back to the first half of the 13th century. They were zealous partisans of the house of Hapsburg, to whom, during the reigns of Frederick II. and Leopold I., they lent a powerful support. In 1238 Peter and Elias, sons of Salomon von Estoras, divided their father's inheritance. The former obtained Zerhaz, the latter Illyeshaza, and thus became the founders of two principal lines, the latter of which became extinct in the male line in 1838, with Count Stephen Illeshazy. Peter's descendants took from their domain the name of Zerhasy, till Francis Zerhazy (b. 1563; d. 1595), vice-regent of the county of Presburg, changed this name into Eszterhazy in 1584, on the occasion of his being named Lord of Galantha. Among noted modern inheritors of the name are PAUL IV., PRINCE ESZTERHAZY, a general and literary savant (1635–1713). His grandson, NICHOLAS JOSEPH, a great patron of arts and music, founder of the school in which Haydn and Pleyel, among others, were formed (1714–90). NICHOLAS, PRINCE ESZTERHAZY, distinguished as a field marshal and foreign ambassador (1765–1833). PRINCE PAUL ANTHONY, a distinguished and able diplomatist (1786–1866), successively Austrian ambassador at Dresden, Rome, and Britain, and a supporter of the National Hungarian movement.

Eszek, es'sĕk, or **Esseg,** Austria-Hungary, a royal free city in Croatia and Slavonia, capital of the county of Veröcze, on the Drave, about 63 miles west-northwest of Peterwardein. It consists of the town proper, partially fortified, and three suburbs, and is the seat of an appeal court for three countries. It has a normal school for the training of teachers. The manufactures are not extensive; but the four annual fairs, chiefly for corn, cattle, and hides, are important. As a Roman colony, founded by the Emperor Adrian, under the name of Mursia, it became the capital of Lower Pannonia, and in 335 was made a bishop's see by Constantine. Pop. 23,216.

Etampes, Anne de Pisseleu, än dė pēs-sē-lė ā-täṅp, DUCHESSE D', French royal favorite: b. about 1508; d. about 1576. She became the mistress of Francis I., but to save appearances he gave her for a nominal husband Jean de Brosse, afterward Duke d'Etampes. The new duchess wielded a paramount influence in the affairs of the nation. Upon the fine arts and in some other directions she exerted a good influence, but the jealousy between her and Diana of Poitiers, the mistress of the Dauphin Henry, became a source of calamity for France. It was chiefly under the influence of this feeling that she betrayed to Charles V. the movements of the French army; and the disadvantageous treaty of Crécy in 1544 was due to the intrigues of Anne and of Diana.

Etampes (ancient STAMPÆ), France, a town in the department of the Seine-et-Oise, at the confluence of the Etampes and Juine, southwest of Paris. It has four Gothic churches, one of them a remarkable structure of the 13th century; tanneries and bleacheries, and a considerable trade in corn, flour, and prepared wool. Pop. 9,310.

Etang, ā-täṅ, is a French geographical term applied to the remarkable salt lagoons and marshes on the south and west coasts of France. The stagnant seawater is generally utilized, as in Brittany and in the department of Bouches-de-Rhone, for the manufacture of salt. The principal lagoons of this character in France are the Etangs de Berre, de Sigean, de la Palme, and de Leucate on the south, and de Heurtin, de Cazan and de Parentes on the west coast.

Etawah, ĕ tä'wä, India, a town in the northwest provinces, 70 miles southeast of Agra, capital of the district of Etawah, situated on the Jamna River. It was once the residence of many of the Mogul grandees, and it is now an important trade centre.

Etching, the art of producing designs on a plate of steel or copper by means of lines drawn with an etching needle (a fine-pointed steel tool), the lines being drawn through a coating or varnish (the ground), and bitten in by some strong acid which can only affect the plate where the varnish has been removed. See ENGRAVING.

Eteocles, ĕ-tē'ŏ-klēz, and **Polynices**, pŏl-ĭ-nī'sēz, two heroes of ancient Greek legend, sons of Œdipus, king of Thebes. After their father's banishment from Thebes, Eteocles usurped the throne to the exclusion of his brother, an act which led to what was known as "The Expedition of the Seven Against Thebes," Polynices being one of the seven leaders. The two brothers fell by each other's hand. The interment of Polynices was forbidden under penalty of death but Antigone (q.v.), his sister, braved the doom decreed. Racine has dramatized this story with some poetical variations in his 'Frères Ennemis.' See ADRASTUS.

Eternal City, The, Rome, the capital of Italy. Legend states that it was raised by or under the immediate supervision of the immortal gods. The term is frequently to be met in classic literature. 'Ave, Roma Immortalis' is the title of a historical work on the Italian capital, by Francis Marion Crawford. 'The Eternal City' is the title of a novel by Hall Caine, published in 1901, the scene of which is laid in Rome. It was dramatized and produced simultaneously in England and in the United States in 1902.

Ete'sian Winds, winds blowing at stated times of the year; applied especially to north and northeast winds which prevail at certain seasons in the Mediterranean regions.

Etex, Antoine, äṅ-twän ā'tĕks, French sculptor, painter, architect, engraver and writer: b. Paris 20 March 1808; d. Chaville 16 July 1888. He took the second grand prize of Rome (1829) with his 'Dying Hyacinthe'; and became a member of the Legion of Honor (1841). Among his other works in sculpture are: 'Cain and His Cursed Race' (1833); 'Resistance of France to Coalition of 1814'; and 'Peace,' for the Arc de l'Etoile; group, 'City of Paris Imploring God for Victims of Cholera'; 'Charlemagne'; equestrian statue of Charles I. Among his paintings are: 'Romeo and Juliet'; 'Faust and Marguerite'; 'Allegorical Glory of the United States,' for City Hall, New York (1853). Among his literary works are: 'Notes on Paul Delaroche' (1857); 'Study of Life and Works of Ary Schæffer' (1859); 'Textbook for the Polytechnical Association, for Students and Workmen' (1861).

Ethane, C_2H_6, a gaseous hydrocarbon belonging to the paraffin series and constituting its second member (the first being methane, or marsh-gas). It occur in the gases that are given off by crude petroleum, and it may be prepared by heating methyl iodide with metallic zinc in closed tubes at 300° F.; the iodide of methyl that is required being obtained by acting upon methyl alcohol (see ALCOHOL) with iodine, in the presence of phosphorus. Ethane is also liberated at the anode, together with carbon dioxide in the electrolysis of a concentrated solution of sodium acetate. It is a colorless gas, which burns with a pale flame, and combines with water, under pressure, to form a crystalline hydrate. At a temperature of 39° F. it may be liquefied by a pressure of 47 atmospheres. Chlorine combines with ethane rapidly, in diffuse daylight, with the formation of ethyl chlorid, C_2H_5Cl; but if excess of chlorine is present, higher substitution products are also formed, terminating with hexachlorethane, C_2Cl_6. Ethane is also known as "ethyl hydrid."

Eth'elbald, king of Wessex: d. 860. He was a son of Ethelwulf, king of the Anglo-Saxons, and obtained the throne of Wessex in 856. While Ethelwulf was making a journey to Rome, Ethelbald formed the project of seizing the throne. A civil war was prevented only by the moderation of Ethelwulf, who resigned to his son the dominion of Wessex, and confirmed that portion of the kingdom to him in his will. The reign of Ethelbald was peaceful, but he excited general disapprobation by marrying, contrary to the canonical law, his stepmother Judith. Ecclesiastical and popular displeasure forced him at length to a separation, and Judith returning to France, eloped from a convent with Baldwin, afterward count of Flanders. From this union descended Matilda, wife of William the Conqueror, and through her the race of English sovereigns.

Eth'elbert, king of Kent: b. about 552; d. 616. He married Bertha, the daughter of Charibert, king of the Franks, and a Christian princess, who, stipulating for free exercise of her religion, brought over with her a Frankish bishop. Her conduct was so exemplary as to prepossess the king and his court in favor of the Christian religion. In consequence, Pope Gregory the Great sent a mission of 40 monks, headed by Augustine, to preach the gospel to the Saxons (597). They were well received, and numbers were converted; and the king himself at length submitted to be baptized. Civilization and knowledge followed Christianity, and Ethelbert, about 600, enacted a body of laws, which was the first written code promulgated by the northern conquerors. At the time of the landing of Augustine, he had acquired a supremacy over all the English south of the Humber. Ethelbert founded the see of Rochester in 604, and afterward that of London. He was succeeded by his son, Eadbald.

Ethelbert, king of Kent and Wessex: d. 866. He was the third son of Ethelwulf, and succeeded to the government of Kent about 855; and in 860, on the death of his brother Ethelbald, became king of Wessex. His reign was much disturbed by the inroads of the Danes, whom he repulsed with vigor, but without permanent success, as, whenever they were driven from one part of the country, they ravaged another.

Eth'elred I., king of England: d. 871. He was the fourth son of Ethelwulf, and succeeded his brother Ethelbert in 866. Assisted by his brother Alfred, Ethelred drove the Danes from the centre of Mercia, where they had penetrated; but, the Mercians refusing to act with him, he was obliged to trust to the West Saxons alone, his hereditary subjects. Notwithstanding various successes, especially a great victory at Ashdown, the invaders continually increased in numbers. Ethelred died, in consequence of a wound received in an action with them, and was succeeded by Alfred.

Ethelred II., king of England: b. 968; d. London 23 April 1016. He succeeded his brother, Edward the Martyr, in 978, and, for want of sound judgment and sagacity, was surnamed the «UNREADY» (without *rede* or counsel). About 981 the Danes, who had for some time ceased their inroads, renewed them with great fury. In his reign began the practice of buying them off by presents of money. After repeated payments of tribute (see DANEGELD) he effected, in 1002, a general massacre of the Danes in England. Such revenge only rendered his enemies more violent; and in 1003 Sweyn and his Danes carried fire and sword through the country. They were again bribed to depart; but, upon a new invasion, Sweyn obliged the nobles to swear allegiance to him as king of England; while Ethelred, in 1013, fled to Normandy with his family. On the death of Sweyn, in 1013, he was invited by the national council to resume the government. Ethelred, in 1002, married, as his second wife, Emma, sister of the Norman Duke Richard II.

Ethelre'da, Saint, East Anglian princess: d. Exning, Suffolk; d. Ely 23 June 679. Although twice married she made and kept the monastic vow of chastity and continence. She finally became abbess of Ely, and the county fair which was held all over the land on her day, after her canonization as Saint Ethelreda or Audrey, gave rise to the expression «tawdry,» as indicating something cheap and fine, such as would be offered for sale in a village booth.

Eth'elwulf, king of England: d. 858. He succeded his father, Egbert, in 839, and soon after his accession associated his son Athelstan with him, giving him the sovereignty over Essex, Kent, and Sussex. In 851 the Danes poured into the country in such numbers that they threatened to subdue it; and though opposed with great vigor by Athelstan, they fixed their winter quarters in England, and next year burned Canterbury and London. After inflicting a great defeat on the Danes at Ockley, he went on a pilgrimage to Rome, and on his return found his son Ethelbald in revolt against him. In order to avoid a civil war, he gave up the western division of the kingdom to his son, retaining Kent for himself. Before going to Rome, Ethelwulf had made certain grants, which used to be regarded as the first payment of tithes in England; but modern authorities reject this view.

Ethendun, Battle of, the victory which Alfred the Great gained over the Danes (878), and which led to the treaty with Guthrum, the Danish king of East England. The locality where the battle was fought is supposed to be at Edington, in Wiltshire.

E'ther, in chemistry, any compound which may be regarded as derived from water by the replacement of each of the hydrogen atoms by a basic or alcoholic radical. The ether is «simple» if the basic radicals that are so substituted are alike, and it is «mixed» if they are unlike. The formation of a simple ether may be conveniently illustrated by the case of common, or «diethyl» ether, $(C_2H_5)_2O$. This may be prepared in various ways, but the sulphuric-acid method will serve best to illustrate the nature of the compound. When alcohol, $C_2H_5.OH$, is heated to 285° F. with sulphuric acid, H_2SO_4, one of the hydrogen atoms of the acid is replaced by the alcohol radical ethyl C_2H_6, according to the equation $C_2H_5.OH + H_2SO_4 = (C_2H_5)HSO_4 + H_2O$, the compound $(C_2H_5)HSO_4$ being known as hydrogenethyl-sulphate, or «sulphovinic acid.» When the hydrogen-ethyl-sulphate comes in contact with another molecule of the alcohol, it undergoes a second transformation, by which another ethyl radical is taken up, and a molecule of sulphuric acid again set free, as indicated by the equation. $(C_2H_5)\ HSO_4 + C_2H_5.OH = (C_2H_5)_2O + H_2SO_4$. It will be seen that although a molecule of sulphuric acid is used up in the first part of the process, it is regenerated in the second part, so that on the whole there has been no change in the quantity of acid present. The water produced in the first stage, and the ether, $(C_2H_5)_2O$, produced in the second stage, pass off in the state of vapor, and the apparatus is ready for the admission of a new supply of alcohol. The process by which an ether is formed, as here illustrated, is called etherification; and the etherification is said to be «continuous» if it can go on, as in this case, by merely passing a stream of the alcohol into one end of the apparatus, and withdrawing the vapor of ether and water at the other end. Methyl ether, for example, can be formed by the action of sulphuric acid upon methyl alcohol in a manner precisely analogous to that explained above. The equations in this case are $CH_3.OH + H_2SO_4 = H_2O + (CH_3)\ HSO_4$; $(CH_3)HSO_4 + CH_3OH = H_2SO_4 + (CH_3)_2O$; where $CH_3.OH$ is methyl alcohol, $(CH_3)_2O$ is methyl ether, and $(CH_3)HSO_4$ is hydrogen-methyl-sulphate.

As an illustration of a mixed ether, the case of methyl-ethyl ether may be cited. If ethyl alcohol be heated with iodine in the presence of phosphorus, a substance known as ethyl iodide is formed. Thus: $5C_2H_5.OH + 5I + P = 5C_2H_5.I + H_3PO_4 + H_2O$. On the right of this equation, H_3PO_4, is phosphoric acid, and $C_2H_5.I$ is ethyl iodide, which is a liquid boiling at 152° F., readily separable from the phosphoric acid by distillation. Now if ethyl iodide be mixed with potassium ethylate (obtained by dissolving metallic potassium in absolute ethyl alcohol), the following reaction occurs, and ethyl ether is formed: $C_2H_5.I + C_2H_5.OK = KI + (C_2H_5)_2O$. But if the ethyl iodide is mixed with potassium *methylate*, $CH_3.OK$, which is obtained by dissolving metallic potassium in absolute methyl alcohol, then the ether that is formed contains the radical methyl, CH_3, and also the radical ethyl C_2H_5, and hence is a mixed ether; $C_2H_5.I + CH_3.OK = KI + C_2H_5.O.CH_3$. The mixed ether, $C_2H_5.O.CH_3$, is known as methyl-ethyl ether. The reactions that have here been given at some length are typical of similar ones that hold true very generally of the alcohols and ethers. In all the more familiar cases the iodide of a given alcohol radical can be prepared by treating the corresponding alcohol with iodine and phosphorus; and a potassium «alcoholate» can be formed by dissolving metallic potassium in the corresponding (anhydrous) alcohol. Then if we wish to prepare a proposed mixed ether, we have only to treat the iodide of one of its radicals with the potassium compound of the other one, as indicated above. The commoner ethers, both simple and mixed, strongly resemble one another in their general properties. Thus they will not mix with water, nor combine with ammonia nor other alkalis, nor with metallic sodium, nor with dilute acids. The resemblance is also close in other respects. (For «compound ethers» see ESTERS.)

Ethyl Ether, Diethyl Ether, or Sulphuric Ether.— When the term ether is used without qualification, diethyl ether, $(C_2H_5)_2O$, is universally understood to be meant, just as ethyl alcohol is understood, when alcohol is mentioned without qualification. The preparation of diethyl ether, by the action of sulphuric acid upon alcohol, has already been described. The substance so obtained is a mobile, colorless, inflammable and very volatile liquid, with a specific gravity of about 0.72 at ordinary temperatures. It will not mix with water to any great extent, but will mix readily with many organic fluids, and also with liquid carbon dioxide. It dissolves resins and fats, and many of the alkaloids. It boils at 95° F., under a pressure of one atmosphere, and at 200° F. below zero it freezes into a crystalline solid, which melts again at about 180° F. below zero.

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Ether, in physics, a hypothetical substance, probably devoid of weight, which is supposed to fill all space, and to penetrate freely among the ultimate particles of which matter is composed. It is not in any way related to the substance known as "ether" to the chemist, and the identity in name is unfortunate. The physicist has the advantage of priority, however, and cannot be expected to change the name because the chemist subsequently appropriated it for something else. Although we know very little about the precise properties of the ether of physics, the admission of its existence is almost a necessity of thought. For we know that light is some kind of a periodic disturbance, and we know that it travels through interstellar space with a definite, finite speed. It would manifestly be absurd to suppose that a motion of any kind could take place in a void, in which there was nothing to be moved; and hence, as has been said, it appears to be a logical necessity to admit the existence of some kind of a luminiferous (light-bearing) ether throughout space. As soon as we begin to inquire closely into its nature, however, we encounter difficulties that have thus far proved insuperable. Obviously our conclusions in this respect will depend to a large extent upon a study of the phenomena of light, and of the kind of motion that would be competent to produce those phenomena. Naturally the assumption was first made that the ether, when submitted to stress, conforms to the same laws of elasticity that hold true in ordinary matter. (See ELASTICITY.) In that case the full mathematical theory of the motion of the ether would involve no less than 21 numerical coefficients, if the ether were anisotropic. But there is every reason to believe that, whatever its nature may be, it is the same in all its parts, and that its properties, whatever they may be, are the same in all directions. If these two facts are admitted — that is, if the ether be admitted to be isotropic — then the number of constants involved in the theory reduces to two. These, as is explained in the article ELASTICITY, are (1) the modulus of compressibility, and (2) the modulus of rigidity. If the ether were analogous to a liquid or a gas, its modulus of rigidity would be zero. It is found, however, that the equations of motion that are obtained by making the modulus of rigidity zero are not at all competent to explain the actual phenomena of light; for in this case the ether-waves would be merely waves of alternate compression and rarefaction, like those of sound in the air, and there could be no such phenomenon as polarization. It must therefore be admitted that the modulus of rigidity of the ether has a definite, finite value, if the ether itself is to be regarded as analogous to other kinds of matter, so far as its general mechanical deportment is concerned. If it be also admitted that the modulus of compressibility of the ether has a definite, finite value, the conclusion is reached that the ether can transmit two essentially different kinds of waves, one of which involves distortions of its parts, while the other involves changes in its density. Of these the first would admit of polarization, while the second would not. Moreover, the two kinds of waves would have, in general, different velocities of propagation; and the fact that all ether-disturbances appear to be propagated at the same speed indicates that only one kind exists, and that we must therefore make one of the three following assumptions with regard to the compressibility of the ether: (1) The modulus of compressibility of the ether is infinite; or (2) it is zero; or (3) the circumstances under which the atoms (or their component electrons) impress their motions upon the ether are such that the modulus of compressibility is not involved in any way. The first of these alternatives implies that the ether is absolutely incompressible, and this is the one that has been most favorably regarded by physicists in general. The second implies that the ether yields indefinitely, even to the smallest compressive forces, so that it is essentially unstable. This view has been developed in recent years by Lord Kelvin, but it is hard to regard it as more than a mathematical possibility. The mind almost refuses to admit that it corresponds to the actual state of affairs in space. The third of the suggested alternatives must also be regarded as improbable, although perhaps we can hardly pronounce it impossible. On the whole, therefore, it is plain that if the elastic behavior of the ether is analogous to that of ordinary bodies, we have to admit (tentatively, at least) that so far as elastic properties are concerned, the ether resembles an absolutely incompressible solid. In the article 'Ether,' in the 'Encyclopædia Britannica,' Maxwell gave estimates of the density and modulus of rigidity of the ether, and these estimates have been widely copied in works on physics, without question, although the computation upon which they are based contains several arithmetic errors. Correcting these, his estimate of the density of the ether becomes 106×10^{-20}, that of water being unity; and his estimate of the modulus of rigidity becomes (when expressed in C. G. S. units) 955, the modulus of rigidity of glass, in the same units, being 24×10^{10}. Roughly, therefore, the calculation may be said to indicate that the ether is about one 1,000,000,000,000,000th as dense as air, and about one 240,000,000th as rigid as glass. Maxwell's computation, however, assumes that the amplitude of an ether-wave is one $\frac{1}{100}$ of its length, and this is a subject upon which we can hardly form an intelligent guess. There does not appear to be any sufficient reason why he could not equally well have taken the amplitude equal to the 100,000th of the wave-length; and if he had done this, he would have concluded the density of the ether to be one 1,000,000,000th of that of air, and its rigidity to be one 240th of that of glass. These numerical estimates are therefore of no particular value. It is not likely, however, that the amplitude of an ether-wave is greater than the value that Maxwell assumes, and hence his results may be taken as minimum limits to the values of both the density and the rigidity of the ether, on the supposition that the assumed analogy of the ether to an incompressible elastic solid is defensible.

According to the elastic-solid theory of the ether, light consists of a periodic or wave-like disturbance in a jelly-like medium, the waves traveling in straight lines with a uniform velocity of about 186,000 miles per second, and the direction of oscillation of the ether being at right angles to the direction in which the wave progresses, just as the direction of oscillation of the various points of a rope along which a wave is passing is at right angles to the rope. This view of the case accords very well with most of the observed phenomena, but there are some that do not appear to be reconcilable with it. We believe that the ether penetrates all bodies, and fills up the spaces between their molecules (or electrons); and as the phenomena of refraction show that the velocity of light is less in a transparent solid (say in glass) than it is in a vacuum, it follows that the ether in the glass has either a greater density or a less rigidity than it has in free space. Either of these suppositions will fit this simple case equally well; but there are other phenomena that will not be satisfied so easily, and it has been found to be impossible to make any single set of consistent assumptions which shall reconcile the «elastic-solid» theory of the ether with all the known facts. For example, when we come to investigate certain problems in partial reflection from transparent media, and others relating to diffraction from small particles, we are obliged to conclude that it is the density of the ether that varies, the rigidity remaining practically constant. On the other hand, the phenomena of double refraction require us to admit that the rigidity of the ether in a doubly refracting body is different in different directions; and hence we conclude that the rigidity of the ether is modified by the presence of molecules of matter — a conclusion at variance with that previously reached by considering the phenomena of diffraction and partial reflection. Other difficulties have been encountered in the application of the elastic-solid theory of the ether to the phenomena of light, and although reference to it is common, because it is definite enough to present a clear image to the mind, and so is helpful in many ways, the general opinion among physicists of the present day is that it is no longer tenable as an accurate description of the real properties of the ether. It has been abandoned in favor of the «electro-magnetic» theory of Maxwell, and in abandoning it we also abandon the method of estimating the density and rigidity of the ether to which reference has been made, above.

Faraday was convinced, many years ago, that there is some mechanism by which magnetic and electric forces are enabled to make themselves felt through a space apparently vacuous. «Such an action,» he said, «may be a function of the ether; for it is not unlikely that, if there be an ether, it should have other uses than simply the conveyance of radiation.» Maxwell, after reading Faraday's writings, became so impressed by the ideas which they advanced that he applied his own ingenious and powerful mind to the problems whose solution Faraday had dimly glimpsed, and succeeded in completely revolutionizing our ideas with regard to light and the ether. His now famous «electro-magnetic theory» is given in his masterly but exceedingly difficult 'Treatise on Electricity and Magnetism,' and a popularized account of it may be found in Oliver J. Lodge's 'Modern Views of Electricity.' He agrees with previous writers that light is some sort of a periodic disturbance in some sort of an ether, and that the displacements that occur are indeed perpendicular to the direction in which the light-wave travels; but he teaches us that these displacements are not analogous to those that are produced in an elastic solid when that solid is deformed. He considers that they are of an electrical nature, and that we must learn about them not by observing the behavior of elastic bodies under stress, but by observing the phenomena exhibited by electrified bodies. Maxwell has given us the fundamental equations that must be satisfied when an electrical disturbance is propagated through the ether, and by means of these equations the entire theory of light can be constructed on the new basis. The theory thus constructed agrees well with the facts of observation, and it is free from the objections that beset the old elastic-solid theory. Moreover, it successfully withstood the searching experimental tests devised and executed by Hertz and his followers, whose labors have shown us that electrical radiations are propagated with the same speed as light, and that they can be reflected, refracted, diffracted, polarized, and made to interfere; so that we are now quite ready to admit that light consists in a rapid succession of such radiations. It is not at all essential to Maxwell's theory that we should know precisely what an «electrical displacement» really is, and hence it does not teach us so much about the nature of the ether as we might expect. It does teach that the elastic-solid analogy is probably not correct, and it strongly suggests that the ether is incompressible, and that there is some kind of an ethereal rotation going on in a magnetic field; but it has not yet been made to furnish a means of estimating the density of the ether, nor of obtaining any of its other constants.

We do not even certainly know whether the ether is continuous, or whether it is molecular in structure. Some writers find it difficult to think of a displacement of any kind, in a space that is entirely filled with matter, especially if the matter is incompressible. Others hold that this objection is without weight.

Faraday's idea that magnetic and electric induction are propagated by the same medium as light proved to be exceedingly fruitful, and it is by no means unlikely that the ether possesses still other functions, which will throw further light upon its nature, when they are understood. The various kinds of radiations that have been discovered in recent years («cathode rays,» «Becquerel rays,» «X-rays,» and the like) were at first believed by many authorities to consist in ethereal motions different from those constituting light, and it was even thought that some of them might correspond to the waves of ethereal compression that had been so earnestly sought. Some of these radiations, however, are now believed to be nothing but ordinary light of exceedingly short wave-length, and others are believed, at least tentatively, to consist in the actual emission of storms of corpuscles, or «electrons,» from the bodies from which they proceed. (See Electron; Radium; Radiation.) Gravitative action has also been attributed to ether stresses, and it is indeed probable that this is its real nature. No mechanical explanation of gravitation, as an ether-phenomenon, has yet been offered, however, to which serious objections cannot be urged. In Maxwell's theory of gravitation it is assumed that bodies produce a stress in the ether about them, of such a nature that there is a pressure along the lines of gravitative force, combined with an equal tension in all directions at right angles to those lines. «Such a state of stress,» says Maxwell, «would no doubt account for the observed effects of gravitation. We have not, however, been able, hitherto, to imagine any physical cause for such a state of stress.» He calculates that to produce the actual effects of gravity, as observed at the surface of the earth, the ether would have to be subject to a pressure of 37,000 tons per square inch in a vertical direction, and a tension of the same numerical magnitude in all horizontal directions.

One of the most obvious difficulties in the way of the ether-theory is that the planets, and even the atoms, move through space as though it were absolutely empty. According to modern notions, however, the atom may be only an aggregate of still smaller «electrons,» each of which may transpire to be nothing but a state of strain in the ether; and if this proves to be the case, we are certainly not in position at present to say that the ether would oppose in the slightest degree the transmission of such a state of strain through its own substance. The difficulty with the theory of aberration is more formidable. If a shower of rain is falling vertically, the drops will appear to an observer to descend vertically so long as he remains stationary. If he moves forward, however, the drops will strike him in the face, and will therefore appear, to him, to come from some point slightly in advance of the zenith, rather than from the zenith itself. A similar phenomenon is observed in connection with light, and is known as aberration. Every star is seen in its true position when the earth is moving directly toward it; but three months later, when the earth is moving at right angles to this direction, the observer's telescope will have to be inclined slightly toward the direction in which the earth is moving, in order that the light from the star may come down through the instrument centrally. The maximum displacement that a star can have, from this cause, is known by observation to be about 20.47 seconds of arc on the heavens. If the ether were motionless, the analogy with the rain-drops would be perfect, and the «constant of aberration,» whose value has just been given, could be calculated from the known velocity of light, and the known velocity of the earth's orbital motion. It is found, however, that the theory of aberration is exceedingly complicated when the possibility of currents in the ether is admitted, and hence physicists have been much concerned to know whether or not the earth drags the adjacent ether along with it, in its motion around the sun. As long ago as 1859 Fizeau showed, by a justly celebrated experiment, that the ether is apparently dragged along by a current of water flowing through a tube; and Michelson and Morley have since shown, by an even more ingenious experiment, that there is evidence that the ether in the immediate vicinity of the earth participates in the earth's motion to such an extent that any difference that may exist does not amount to the twentieth part of the whole motion. Lodge, on the other hand, found no evidence of any «ether drag» in the space between two rapidly whirled steel plates that were separated by an interval of one inch. (See Preston, 'Theory of Light.') The whole subject of the «drag» of the ether is still unsettled; but the observed value of the constant of aberration appears to require that the ether is not disturbed by the motion of the earth through it.

The most noteworthy book on the ether, in recent times, is Larmor's 'Æther and Matter,' which (like all other advanced works on the same subject) is difficult reading. Consult, also, Drude, 'Physik des Æthers.'

Etherege, ĕth'ėr-ej, **Sir George,** English dramatist: b. about 1635; d. 1691. In 1664 appeared his first comedy, 'The Comical Revenge, or Love in a Tub'; an incongruous mixture of prose and verse, but suited to the taste of the times, and well received. The author was immediately enrolled among the courtly wits of the day, and in 1668 brought out 'She Would if She Could,' which was very coarse and licentious. In 1676 he produced his third and last comedy, entitled 'The Man of the Mode, or Sir Fopling Flutter.' This performance was still more applauded than the preceding, and the Sir Fopling was, for a long time, deemed the ideal of the superlative beau or coxcomb of the age. Etherege's plays are little more than lively conversation pieces, with a great paucity of genuine humor or felicitous plot.

Ethical Movement and Ethical Societies in America and Abroad. The first Ethical Society was established and the Ethical Movement inaugurated in 1876 in New York by Felix Adler, then a lecturer at Cornell University. In response to a call, several hundred persons met in May at Standard Hall, and at the conclusion of Prof. Adler's address, outlining the purpose and spirit of the proposed organization, the Society for Ethical Culture of New York was constituted. In this address he appealed to his auditors to unfurl a new flag of peace and conciliation over the bloody battlegrounds where religions had fought in the past; he laid stress upon the urgent need of a higher and sterner morality to cope with the moral perils of the hour, especially noting the growing laxity that accompanied the decline of discredited forms of religious belief; and he placed peculiar emphasis upon the duty of caring for the moral education of the young. The society thus initiated grew rapidly, and soon gave practical effect to his programme. Within a few years it had established a free kindergarten for the children of the poor, the first of its kind in New York; and this developed into a workingman's school, based upon the Froebelian pedagogy, which was the first school to introduce manual training and systematic ethical instruction into the curriculum. It also inaugurated a system of trained nurses for the poor, which has since become an adjunct of dispensary out-door relief in the city. Nor were the larger social and political applications of morality to contemporary life neglected: its leader devoting special attention in his platform utterances to the labor problem and specific social reforms, as being at bottom great moral issues. His vigorous exposure of the evils of the tenement houses bore fruit in the creation of the Tenement House Commission of 1884, of which he was appointed a member. He also was among the first advocates of small parks in the congested districts, of public playgrounds and public baths; and, above all, of greater justice and humanity in the relations between labor and capital, employer and employed. The Labor party here found a new type of advocate; and reformers and politicians a platform from which the issues of the hour were brought to the touchstone of ethical first-principles.

Meanwhile, the society filled more and more the place of a church in the lives of its hitherto unchurched members. It did not neglect the problems of the personal life; but aimed to illuminate and inspire its members in their dealings with the problems of the home and the vocation, family relations, marriage, the training of the young, etc. Its position as a distinctive religious organization became better understood and its religious appeal more forcibly felt, while its practical educational and philanthropic activities continued to multiply. Its schools, testifying to its conviction that moral improvement must begin with the care and education of the young, expanded until kindergarten, normal and high school departments were added. These have for some time been inadequately housed. The Sunday audiences, too, have twice outgrown their accommodations. To meet its requirements, the Society is erecting at Central Park West and 63d Street, a thoroughly modernized school building, next to which an appropriately dignified meeting place and society-house will later on be added. The very thoroughly equipped schoolhouse will enable the society, in greater measure even than in the past, to fulfil its cherished aim of having a model and experimental school, standing for the highest ideals of non-sectarian education and the most efficient pedagogical methods of realizing them. What distinguishes these from many other similar schools is their democratic organization and spirit: like the public schools, they educate children both of the well-to-do and of the poor, that is, an equal proportion of pay pupils and pupils admitted under a system of free scholarships endowed by the Society.

To give further effect to its conception of a religious society as a body of workers, bent upon learning by doing and promoting piety by service, the society opens to its members many other fields of education and philanthropic activity. Here the women of the society take a prominent part. Most of the philanthropies are affiliated under a general representative body known as the Women's Conference, through whose recent initiative and effort the Manhattan Trade School for Girls was established. Fortunate in drawing an unusual number of young men to its ranks, the Society has a strong Young Men's Union which contributes largely to the support of two neighborhood houses: the Hudson Guild on the West Side, of which Dr. John Lovejoy Elliott, one of Prof. Adler's associate lecturers, is the head worker; and the Down-Town Ethical Society, on the lower East Side. The Union also owns and supports a summer home on its farm of 70 acres at Mountainville, N. Y., where a farm school is held, and a summer holiday is given to groups of the boys and girls who belong to the Neighborhood clubs. The larger policies and relations of all the working bodies of the society are considered and shaped by a Council of Fifty, composed of representatives from all of them. One other event in the history of the society that calls for mention is the recent appointment of Prof. Adler to the newly created chair of political and social ethics at Columbia University. As the chair was endowed with a view to Prof. Adler's tenure of it at the instigation of some members of the well-known Committee of Fifteen appointed by the Chamber of Commerce to deal with the social evil in New York, of which committee Prof. Adler was an active member, this appointment is a remarkable public tribute to the large public place which the founder of the ethical movement has won for himself and for it.

Early in the history of the society, a number of young men were attracted to it, and, after a period of apprenticeship in New York, went forth to found societies in Chicago, Philadelphia, and St. Louis, and across the seas in London. These American societies are under the leadership respectively of William M. Salter, S. Burns Weston and Walter L. Sheldon; and, while loosely federated in a union, they maintain an individuality of their own, and have developed different forms of activity according to local needs and circumstances. They all hold Sunday exercises, which consist for the most part of music, readings, and an address. All admit to membership on a simple declaration of devotion to the ethical ends set up. All attach great importance to the moral and religious education of the young, and maintain well-organized Sunday schools and associations and clubs of young men and young women devoted to the same end and to various kinds of practical work. From the publishing and literary headquarters of the Ethical Union in Philadelphia (S. Burns Weston, 1305 Arch Street) is issued monthly 'Ethical Addresses,' containing the more important lectures of the leaders; and the 'International Journal of Ethics,' under a committee of ethical specialists in America and Europe with Mr. Weston as managing editor. The New York society publishes bi-monthly the 'Ethical Record,' a journal of practical ethics, edited by Percival Chubb, also one of Prof. Adler's associate lecturers. Among the literary products of the American societies are Prof. Adler's 'Creed and Deed,' 'Moral Instruction of Children,' and 'Life and Destiny'; Mr. Salter's 'Ethical Religion'; Mr. Sheldon's 'An Ethical Movement,' 'An Ethical Sunday School,' and 'Old Testament Bible Stories as a Basis for Ethical Instruction of the Young.'

That the movement initiated in America expressed no merely local phase of religious development is evident by its still more rapid spread in Europe. American influences led to the establishment in 1886 of the London Ethical Society with which Profs. Muirhead, Bosanquet, Bonar, and others, upon whom the ethical influence of Thomas Hill Green of Oxford had been profound, were identified; and under its auspices lectures were given at Toynbee Hall and elsewhere by many men at the universities and in public life who felt the importance of the new ethical propaganda, such as Seeley, Caird, Leslie Stephen, etc. About the same time Dr. Stanton Coit went over from New York to assume (*vice* Mr. Moncure D. Conway) the leadership of the congregation at South Place Chapel, then renamed the South Place Ethical Society, which, after a brief pastorate, he resigned to push the ethical cause in other ways. Under his energetic leadership, the ethical societies have multiplied rapidly in London and in the provinces, where also several of the Labor Churches have affiliated themselves with the ethical movement. A Union of Ethical Societies (14 or more), and a Moral Instruction League (to introduce systematic non-theological, moral instruction into all schools) are in vigorous activity; a weekly paper, 'Ethics,' has been maintained for several years; and there has been a considerable output of literature, including Dr. Coit's anthology, 'The Message of Man,' a 'Collection of Ethical Songs,' and, edited by him for the Society of Ethical Propagandists, a volume of essays by different writers, entitled 'Ethical Democracy'; Quilter's 'Upward and Onward,' a book for boys and girls; Sander's 'Reorganization of the People'; McCabe's 'Discipline in the Roman Church.' In London there is also an independent Ethical Religion Society, founded and led by Dr. Washington Sullivan. Ireland, likewise, has been reached, where there is an ethical society at Belfast. At Leicester, Eng., F. J. Gould, the leader of the Secularist Society there, has advanced the ethical instruction of the young by his 'Children's Books of Moral Lessons' (two series), and by his effective advocacy of the cause on the Leicester School Board, which he has forced to take an advanced position on the subject of moral instruction in the board schools.

The new movement was finding, meanwhile, favorable soil on the Continent. A centre of activity was established at Berlin, where Prof. Gizycki, Prof. William Foerster, and others identified themselves with the cause. Societies were in time established at Munich, Dresden, Danzig, Freyburg, Stuttgart, Breslau, Frankfort, Jena, Magdeburg, Strassburg, Ulm, Königsberg; and in Austria at Vienna, in Italy at Venice and Rome, in Switzerland at Zürich and Lausanne; and in France through the Union pour L'Action Morale (1891) which found spokesmen in M. Emil Desjardins (notably in his stirring brochure 'Le Devoir Present'), and in other well-known writers. Among the latest additions to the ethical societies is one at Tokyo in Japan. The German societies support a weekly paper, 'Ethische Kultur,' published at Berlin; and the Parisian society a monthly, entitled 'La Coöpération des Idées.'

The increasing activity in these European centres led to the establishment of an international organization with a central station at Zürich, and Prof. F. W. Foerster as secretary and organizer. Here in September 1896 an International Congress was held which issued a representative manifesto. It is largely colored by a continental sense of the urgency of applying ethical principles in the domain of social and political affairs. It announced its sympathy with the efforts of the populace to obtain a more human existence; but recognized as an evil hardly less serious than the material need of the poor, the moral need which exists among the wealthy, whose integrity is often deeply imperilled by the discords in which the defects of the present industrial system involve them. It demanded that the social conflict should be carried on within the lines prescribed by morality, in the interest of society as a whole, and with a view to the final establishment of social peace. It appealed to the ethical societies to provide the intellectual armor for this struggle, and to all their members to promote the progressive social movement by simplicity in the conduct of life and the display of an active social spirit. It declared (in view, doubtless, of prevailing scepticism and license) the pricelessness and indispensableness of the institution of pure monogamic marriage; demanded opportunity for the fullest development for women; advocated the improvement of the lot of female wage-earners in industrial establishments; and made a strong plea for the restoration of lost unity in the educational system by setting up a common ethical purpose as the aim of all culture. It declared for universal peace, and against militarism and the national egotism and jealousy which precipitate war. Finally, it urged upon all ethical societies not simply to concern themselves with these practical issues, but to devote their utmost energy to the building up of a new ideal of life in harmony with the demands of modern enlightenment. This manifesto represents most, but not all, of the leading interests of ethical societies. It expresses their almost universal interest in the social question, and their desire to bring theories, policies and measures of reform to the test of ethical principle; it expresses also their interest in promoting peace and an education animated and unified by an ethical purpose. It does not, however, lay stress upon the relation of the movement to modern liberalism, its frank acceptance of the spirit and results of modern science, and its repudiation of the supernatural, miraculous, and priestly elements in religion; nor does it voice the deeper religious seriousness and spirituality of the movement. By some of the leaders this latter is very strongly emphasized; and some of the ethical societies are primarily churches for inspiration and guidance in the difficult effort to lead the good life.

While the inception of the ethical movement was due to the insight and prevision of Felix Adler, and its first powerful impact due to his attractive eloquence and personal power, its rapid growth to international dimensions is clear evidence that it met a deep and widespread need. It was fitly born on American soil; for a new ethical religion and ethical church for America had been definitely prophesied and sketched by Emerson in his later essays on 'Worship' and 'The Sovereignty of Ethics.' He had said: "The progress of religion is steadily to its identity with morals. . . . It accuses us that pure ethics is not now formulated and concreted into a cultus, a fraternity with assemblings and holy days, with song and book, with brick and stone. . . . America shall introduce a pure religion. . . . There will be a new Church founded on moral science; at first cold and naked, a babe in a manger again, the algebra and mathematics of ethical law, the church of men to come, without shawms, or psaltery, or sackbut; but it will have heaven and earth for its beams and rafters, science for symbol and illustration; it will fast enough gather beauty, music, picture, poetry.» The development of advanced Unitarianism through Channing and Parker had been in this direction. It had two practical outcomes — the Free Religious Association, which still holds annual sessions; and the Ethical Movement. As distinguished from the Free Religious Association, which expressed vaguely the libertarian tendencies of Emerson's thought, the Ethical Movement gave effect to the positive and constructive tendency which found clear utterance in his prophecy. Although this positive spirit was present in the religious society conducted in New York by Octavius B. Frothingham—who was wont to say, after he had retired and it had disbanded, that its legitimate successor was the Society for Ethical Culture—it was not until Felix Adler brought to the new movement at once an ethical outlook and philosophy learned chiefly in the school of Kant, an impassioned Hebraic sense of religion as righteousness of life, and a practical sense of the urgency and ethical import of the great impending moral issues in the social, industrial, and political world, that conditions existed for the full birth of the new ethical religion.

The most distinctive feature of this new phase of religious development was that it did not propose to add to the religions of the past, in the way in which these had multiplied, namely, on the basis of differences of speculative belief. Instead, it announced the basic importance and the priority of the ethical factor in religion. It approached religion, not from the credal, but from the practical moral standpoint; and it saw, in a common affirmation of this priority and supremacy of virtue and the good life, a ground of union for people of varying philosophical convictions, or none. Following Emerson, it asserted that character and conduct condition creed and thought; and that it is only by sowing a worthy character that men can reap a vital and meaningful creed. It contended that no certain and lasting basis of union can be found in anything so variable and personal as one's philosophical view of the world; and that no one should pledge his intellectual future by subscribing to-day to a creed which to-morrow he may outgrow. What a man thinks is the result of what he is,— the outcome, therefore, of his action, his experience, his effort and his love, far more than it is the outcome of his deliberate thought and accumulated knowledge. This position differed from that of the Comtian Positivists because theirs assumed a final, definite, and in some respects, very negative philosophy. The new movement allowed for the greatest individual differences in men's philosophical interpretation of life, save in the one tenet that all must acknowledge the sacred obligation imposed by man's moral nature to live the good life and to follow without swerving the dictates of duty according to the best light that is in each.

On the basis of this moral earnestness and this attitude of moral resolve men may safely and hopefully work backward into a philosophy and forward into a faith. Their philosophy and their theory of moral sanction may be what it will, theistic or pantheistic, materialistic or idealistic; it may or may not issue in a faith in immortality, conditional or absolute. This is a personal concern, and the statements on such matters frequently made by the leaders of ethical societies who differ much in their philosophies, are merely expressions of personal conviction, and not made as in any way committing the societies. This is to make a clear distinction between the private and the public factors of religious belief; and to find as the only possible basis for religious union, for those who would jealously guard their intellectual integrity, a moral aim by which any man should be ashamed not to be bound.

The ethical movement has been criticized, notably of late by Charles Booth, in his concluding volume reporting the life of the poor in London, as lacking in imaginative color and appeal, and therefore unlikely to spread among the masses of the people. Perhaps Emerson was right in emphasizing the austerities of the new religion in its early protestant phases. But at heart it is genial and passionately human. It has nothing sensationally novel to offer; it does not compete with picturesque claimants like Theosophy, Christian Science, Vedantism, etc., and it may be a fact that «plain goodness,» «mere morality,» «the beauty of holiness,» will not yet draw many with their old-new evangel. And yet one finds among its adherents nothing less than a new type of the religious temperament, voicing a new imaginative sense of the hidden mysteries and wonders of the moral personality, the new unrevealed heights and depths of the moral life, the unrealized joyousness of devotion to duty and to service.

PERCIVAL CHUBB,
Editor the 'Ethical Record.'

Ethics (from Gr. ἠθικά, having to do with conduct, from ἦθος, character, lengthened form of ἔθος, custom, manners; *cf.* morals, from Latin, *mos, mores,* customs), that branch of the theory of conduct which is concerned with the formation and use of judgments of right and wrong, and with intellectual, emotional, and executive, or overt, phenomena, which are associated with such judgments, either as antecedents or consequents. As a branch of the theory of conduct, it is generically akin to the sciences of jurisprudence, politics and economics; but it is marked off from such sciences in that it considers the common subject-matter of human conduct from the standpoint of rightness and wrongness. Such terms as good and evil, the dutiful or obligatory, might be used in the definition as substitutes for the terms «right» and «wrong,» but good and evil are somewhat too wide in scope, including, for instance, economic utilities, commodities and satisfactions; while duty is somewhat too narrow an idea, emphasizing the notion of control at the expense of the idea of the good and desirable. «Right» and «wrong» designate exactly those phases of good and evil to which the idea of the obligatory is also applicable. The terms moral philosophy, moral science, and morals have also been used to designate the same subject of inquiry.

In its historical development, ethics has been regarded as a branch of philosophy, as a science, and as an art — often as a composite of two or all of these in varying proportions. As a branch of philosophy, it is the business of ethics to investigate the nature and reality of certain conceptions in connection with fundamental theories of the universe. It is the theory of reality in its moral aspect. The term good is taken to denote or describe a property of ultimate and absolute being. As such, it is usually co-ordinated with two other fundamental properties of reality, the true and the beautiful; and the three philosophic disciplines are defined as ethics, logic, and æsthetics. Even when so much emphasis is not thrown upon the place of the good in the general scheme of the universe, ethics may still be regarded as a branch of philosophy, because concerned with the ideal, with what ought to be, or with what is absolutely desirable, as distinct from the actual, the existent, the phenomenal. From this point of view, ethics is regarded as *normative* in character, that is, concerned with establishing and justifying certain ultimate norms, standards, and rules of action.

In contrast with such functions, ethics as a science is concerned with collecting, describing, explaining and classifying the facts of experience in which judgments of right and wrong are actually embodied or to which they apply. It is subdivided into social, or sociological, ethics, and individual, or psychological, ethics. (*a*) The former deals with the habits, practices, ideas, beliefs, expectations, institutions, etc., actually found in history or in contemporary life, in different races, peoples, grades of culture, etc., which are outgrowths of judgments of the moral worth of actions or which operate as causes in developing such judgments. Up to the present, social ethics has been developed mainly in connection, (1) with discussion of the evolution of morality, either by itself or in connection with institutions of law and judicial procedure, or of religious cult and rite; or (2) with problems of contemporary social life, particularly with questions of philanthropy, penology, legislation, regarding divorce, the family and industrial reform — such as child-labor, etc. In both aspects it is closely connected with the science of sociology. It is sometimes called inductive, or in its second aspect, applied ethics. (*b*) Psychological ethics is concerned with tracing in the individual the origin and growth of the moral consciousness, that is, of judgments of right and wrong, feelings of obligation, emotions of remorse, shame, of desire for approbation; of the various habits of action which are in accord with the judgment of right, or the virtues; with the possibility and nature, from the standpoint of the psychical structure of the individual, of free, or voluntary, action. It gathers and organizes psychological data bearing upon the nature of intention, and motive; desire, effort and choice; judgments of approbation and disapprobation; emotions of sympathy, pity in relation to the impulse of self-preservation and the formation and reformation of habit in its effect upon character, etc. In other words, it treats behavior as an expression of certain psychical elements and groupings, or associations: psychological analysis.

Ethics as an art is concerned with discovering and formulating rules of acting in accordance with which men may attain their end. These rules may be considered as of the nature either of injunctions or commands, which prescribe as well as instruct; or as technical formulæ which indicate to the individual the best way of proceeding toward a desired result, thus not different in kind from rules of painting, or of carpentry. Which view is taken depends usually upon the kind of philosophy with which ethics as an art is associated. Ethics as an art may also be an outgrowth of either a general philosophy of conduct, or of a scientific analysis of it. Thus, from the philosophic point of view, a recent writer, Sorley, in the Dictionary of Philosophy and Psychology (Vol. I., p. 346, 1902), says of ethics: "It has to do not merely with actual conduct, but with right or good conduct, and accordingly with an ideal from which rules may be laid down for actual conduct." It is clear that the philosophical establishment of the ideal is considered to terminate in rules for its attainment. On the other hand, Jeremy Bentham in his 'Principles of Legislation' (1789), having before insisted that ethics is a science whose truths are to be discovered "only by investigations as severe as mathematical ones, and beyond all comparison more intricate and extensive," goes on to define ethics "as the art of directing men's actions to the production of the greatest possible quantity of happiness," and says it is the business of private ethics "*to instruct* each individual in what manner to govern his own conduct in the details of life." Thus as an art ethics may be grounded upon either a philosophy or a science.

As may readily be inferred from the above account, some of the most serious problems of ethics at present are concerned with defining and delimiting its own scope, basis and aims. From a purely abstract point of view, all three conceptions can exist harmoniously side by side. It is possible theoretically to regard certain topics as assigned to ethics as a branch of philosophy, others to its scientific phase, and others to the practical, or to ethics as an art. But no consensus as to these various possible assignments exists. Usually those who insist that ethics is a branch of philosophy deny that it can be anything else; they deny that any descriptive and explanatory account of *actual*, as distinct from ideal, conduct, deserves the name of ethics. What we have above treated as belonging to the science of ethics is by them treated as really a matter of history, sociology and psychology, not of ethics proper at all. Thus Green, 'Prolegomena to Ethics' (1883), begins by attempting to prove that a natural science of ethics is inherently impossible, because moral conduct by its nature implies an ideal that transcends actual conduct which alone can be made a matter of observation and experiment, and sets up an obligation which in its absoluteness transcends all the sanctions of experience. On the other hand, those who have occupied themselves with the scientific analysis of moral behavior and character, have usually denied the legitimacy of the philosophic aspect. Thus Bentham expressly regards all philosophical inquiries as doomed to result in sterility, in mere dogmatic personal assertions, or, as he calls them, "*ipse dixits*." A more recent writer, Leslie Stephen, 'Science of Ethics' (1882), without absolutely denying the possibility in the remote future of a metaphysics of conduct, says that the metaphysical view is entirely irrelevant to a scientific treatment. Along with this uncertainty as to the defining aim and characteristic methods of ethics, are naturally found a large number of subordinate and secondary controversies and divisions of opinion.

As a matter of fact, however, in every historical period there have been found in ethical theories some connection with general philosophic thought, and with the data of behavior exhibited in experience (or the scientific aspect) and with the further direction and conduct of life — the practical aspect. Historically, ethics has passed through three epochs: (1) the Græco-Roman; (2) the Patristic-Mediæval; (3) the Early Modern; terminating with say the French Revolution, and may now be regarded as having entered upon a fourth stage. In each period, a certain practical interest is uppermost in social life, and this interest serves to concentrate and direct attention toward certain relevant theoretic problems. An adequate account of ethical thought accordingly is possible only in connection with the larger civilization and culture of which it is a part. Brief characterizations of the main problem of each epoch in its wider social tendencies will serve, however, to point out (*a*) the philosophic, (*b*) the scientific, (*c*) the practical centre of ethics in each period.

The Græco-Roman period was characterized by the disintegration of local custom, tradition and institution, civil and religious, coincident with the spread of cosmopolitan learning and the formation of an inclusive political organization taking effect in both legislation and administration — Greek culture and the Roman empire. With the disintegration of the habits and modes of life which had previously defined the sphere of legitimate individual satisfaction, and which supplied the sanctions of the moral life, there was necessarily coincident an inquiry which attempted to establish through reflection adequate substitutes for the waning institutional modes of control. One of the results of modern historical science is the proof of the extent and stringency of the force of custom in early life. It is custom which defines the morally right and obligatory, and it is custom which enforces its own demands. In it are bound together morals, law, and religion, and all are bound into the very life of the people, emotional and intellectual, as well as practical. Where custom rules, moral theory is unnecessary and indeed impossible. In the 6th and 5th centuries before Christ, this régime of custom was irretrievably shaken in the Greek world, and with a twofold result upon morals. Many thought that all sanctions for morality had disappeared, or at least lost validity, and that pure individualism in thought and conduct — tempered at best only by some judicious regard to consequences — was the proper outcome. Others, prevented by what they regarded as the low moral standards of customary morality from coming to its defense were also shocked by the demoralization attendant upon ethical individualism, and set to work to discover a universal and unassailable basis for a higher type of ideal morality. In this conflict, ethical theory was born.

The Græco-Roman Period (6th century B.C. to 5th A.D.) — The controversy originated in a discussion as to whether morality exists by convention (νόμω), by arbitrary enactment (θέσει), or in reality, that is (in the terminology of the time), «by nature,» (φύσει), or in the nature of things. Some of the Sophists taught that morality was a creature of the efforts of the rulers of a community, being a device on their part to keep others in subjection for the better indulgence of their own desires — much as many of the «free-thinkers» of the 18th century (in many respects the modern congeners of the Sophists) taught that religion was an invention of state-craft and priest-craft. Others taught that it was a product of social agreement or institution. Some of the nobler Sophists (like Protagoras, see the Platonic dialogue of the same name) interpreted this as praise of the state of civilization and culture as against the raw, crude state of nature; while others taught that it was merely a conventional means to personal satisfaction, and hence had no binding force when short-cuts to happiness were available. In the meantime, the actual moral discipline of the Greek city-state was much relaxed, partly because of the interminable dissensions of party strife; and partly because the religious beliefs which were the foundation of civic life were fast becoming incredible. Socrates (about 470 B.C.–399 B.C.) was apparently the first to undertake a positive and constructive analysis of moral ideas. He made the following contributions: (1) All things have to be considered with reference to their end, which indeed constitutes their real «nature»; the end of each thing is its good. Man must therefore have his own end, or good; this is real and inherent, not conventional nor the product of law. (2) To know is to grasp the essential, real being of a thing — its «nature,» or end; «know thyself» is the essence of morality; it means that man must base his activity upon comprehension of the true end of his own being. All evil is really involuntary, based on ignorance, or misconception of man's true good. To be ignorant of the good is the one disgrace. If a man does not know it — and Socrates professed that he did not — he can at least devote himself seriously to inquiring, to the effort to learn. If not wise (a sophist) he can at least be a lover of wisdom (a philosopher). And until he attains knowledge, the individual will be loyal to the responsibilities of his own civic life.

The two conceptions of the good as somehow the fulfilment of man's true nature or reality, and as attainable only under conditions of rational insight are the bases of all later Greek thought. Opinions differed to what man's end is, and as to the character of true knowledge of it. The extreme division was between the Cynic school, the forerunner of the Stoics, founded by Antisthenes (about 444 B.C.–369 B.C.), and the Cyrenaic (the precursor of Epicureanism), founded by Aristippus (about 435 B.C.–360 B.C.). The former taught that virtue, manifested in temperance or self-control, is the one and only good, pleasure as an end being evil, and that it is known by pure reason. The latter taught that pleasure, known only in feeling (the sensation of a gentle and continuous change) is the good. The wise man of Socrates is he who knows this moderate and enduring pleasure and is not captured by sudden and violent passion. Both schools take a somewhat antagonistic attitude toward the state; the Cynic emphasizing the superiority of the sage to government and authority, well illustrated in the anecdotes of Diogenes and Alexander the Great; the Cyrenaic holding that the pleasures of friendship and social companionship of the congenial are superior to those of participation in public life. These schools thus set two of the fundamental problems of subsequent ethical theory, namely, the nature of the good, and the nature of knowledge of it; and supplied the framework of later schools of thought. Those who hold that pleasure is the good are termed Hedonists (Gr. ἡδονή, pleasure) those who held to its residence in the virtuous will Perfectionists, or (with certain qualifications added) Rigorists. Those who hold that it is known through reason are Intuitionalists, the other school, Sensationalists or Empiricists.

Plato (q.v.) (about 427 B.C.–347 B.C.) attempted a synthesis of the conceptions of the two schools just referred to, with a constructive programme of social, political and educational reform, and with a reinterpretation of earlier philosophic theories of the universe and of knowledge. His most characteristic doctrines are (1) the generalization of the Socratic conception of the good as constituting the true essence or nature of man. Under the influence of philosophic concepts derived from a variety of sources, Plato conceived man as essentially a microcosm; as the universe in miniature. He is composed of a certain arrangement of the elements of reality itself; hence he can be truly known only as the real nature of the universal reality which constitutes him is known; his good is ultimately one with the final cause or good of the universe. Thus Plato goes even farther than Socrates in asserting that morality is by nature — it is by the nature not only of man but of absolute reality itself, which is thus given an ethical or spiritual interpretation. Thus he grounded ethics on general philosophic conceptions and has been the model for all since who have distinctly conceived ethics to be a branch of philosophy. Moreover, since he regards the ultimate good of the universe as one with God and as the animating purpose in the creation of physical nature, he brings ethics into connection with religion, and with man's relations to the world about him. (2) Plato regarded the state in its true or ideal form as the best embodiment or expression of the essential nature of individual man; as indeed more truly man than any one individual. In its true organization, it reflects or images the constitution of the ultimate good. Thus Plato brings ethics back into connection with politics as the theory of ideal social organization. Practically, he delineates this state in outline (especially in his Republic, and, with greater attention to feasible detail in his Laws), and proposes in view of this ideal a specific reform of the existing order, instead of disregard of it as with Cynic and Cyrenaic. (3) He sets forth a scheme of the good as realizable in human nature, which endeavors to combine the one-sided extremes of mere pleasure, and mere virtue. He conceives the good to be the fulfilment of all the capacities, faculties or functions of human nature, the fulfilment of each power being accompanied with its own appropriate pleasure, and all being ordered and bound together in a harmonious whole by a law of measure or proportion which assigns to each its proper place; at the head, the pleasure of pure knowledge; at the bottom, the appetites; between, the pleasures of the nobler senses (sight and hearing), and of the higher impulses — ambition, honor, etc. The right functioning of each is virtue; its product is pleasure. The system of pleasures according to virtue is the good. Moreover, he specifies four cardinal virtues which result — wisdom, the knowledge of the good or organized whole; justice, the law of proportion or measure; courage, the assertion of the higher tendencies against the pleasures and pains arising from the contemplation or imagination of the lower; temperance, the law of subordination in accordance with which each lower function is restrained from usurping the place of the higher. Plato's system of ethics remains the standard of ethical theories of the «self-realization» type.

Aristotle (q.v.) (384 B.C.–322 B.C.) gave the philosophic considerations of Plato a more scientific and empirical turn — a contrast, however, which is often exaggerated. He protested against the identification by Plato of human end or good with that of the universe, and consequently attached less importance to knowledge in the form of philosophic insight, and more to practical insight or wisdom. But, in the main assuming the Platonic basis, he carried into detail the analysis of human faculties or functions involved in conduct, giving a careful analysis of desire, pleasure and pain, of the various modes of knowledge, of voluntary action, and making a remarkable analysis of the various forms of virtue and vice actually current. In a word, he emphasized in detail psychological and social aspects, merely sketched by Plato. On the social side, it had become obvious that the comprehensive scheme of reform entertained by Plato was impossible; and here, also, Aristotle is free to undertake a more empirical description and analysis of various forms of government and organization in their moral bases and bearings. When, in the 12th and 13th centuries A.D. the works of Aristotle were again made known to the European world, first through translations from the Arabic and then from the Greek, Aristotle's ethics became embodied in the official philosophy of the Roman Catholic Church, especially in the writings of St. Thomas Aquinas (1225–74), and found literary expression in the Divine Comedy of Dante. His ethical writings have more profoundly affected common speech and thought than those of any other writer, and to a large extent have become a part of the moral common-sense of civilized humanity.

The details of later ethical philosophy in Greece and Rome form an interesting part of the history of ethics, but, with one exception, supply no new idea of sufficient importance to need mention here. The exception is the Stoic conception of virtue as «living in accordance with nature,» and the conception of the «law with nature.» which grew out of this. This idea, under the form of *jus naturale,* was taken up into Roman jurisprudence, and became the ideal of a common moral law which underlies all differences of positive, municipal law, and which, accordingly, forms an ethical standard by which positive law can be tried, and its diversities reduced to a common denominator. It reappeared in the Middle Ages in the form of the natural law (as distinct from revealed or supernatural law), written on the «fleshly tablets of the heart,» and was thus indirectly influential in forming the still current notion of *conscience* as a moral legislative force. It came out in continental ethical thought of the 17th and 18th centuries in the conception of moral law as something analogous to a system of mathematical axioms, definitions and demonstrations, discoverable by reason, and forming the framework of both individual and political ethics.

Patristic Mediæval Period (5th to 15th centuries A.D.) — The second period of ethical history is characterized by the subordination of ethics, as a branch of philosophy, to theology. The distinctive features contributed in this period to subsequent ethics are the emphasis laid upon ideas of law, authority, obligation or duty, and merit or demerit, namely, the good as religious salvation involving a knowledge and love of God as supreme perfection, possible only in the next world; and evil as sin, guilt also needing supernatural expiation. Because of the emphasis upon law and authority, moral ideas are largely assimilated to forensic and juridical conceptions. Most significant, however, for ethical theory is the transfer of theoretical interest from the conception of the good, the central idea of ancient ethics, to that of obligation. Not the natural end of man, but the duty of absolute submission of will to transcendent moral authority was the keynote. And even when ethics was freed from subservience to theology, it still remained easier for the modern mind to conceive of morality in terms of the nature and authority of duty than as the process of realizing the good. On the more concrete, empirical side, the great contribution of mediæval theory was in depicting the moral drama, the struggle of good and evil, as it goes on in the individual soul. The fact that this was fraught with significance for an endless future life made it a subject of anxious and minute attention; and here, too, even when the moral region was later marked off more or less definitely from the religious, modern thought owes its consciousness of the subtle perplexities, temptations and shades of moral effort and issue to mediæval rather than to ancient ethics.

Early Modern Period (The Reformation to the French Revolution).—The complexity and variety of moral theory and inquiry since the 15th century, as well as its relative nearness, make it difficult to secure the perspective necessary to its proper characterization. It is all more or less connected, however, with the struggle toward greater individual freedom, and with the problem of maintaining a stable associated and institutional life, on the basis of recognition of individuality — the democratic movement. In its earliest period, modern ethics was largely characterized by reaction against scholasticism; it was an effort to secure a basis for ethics free from subordination to theology and to mediæval philosophy, and the schoolmen's versions of Aristotle. Moreover so much of energy was expended in the practical effort to get freedom of thought, of political action, of religious creed, of commercial life, that moral theory turned largely upon detailed questions arising out of the practical struggle. This accounts to a considerable extent for the scattered, fragmentary condition of modern ethics as compared with the systematic character of either Greek or mediæval thought. Moreover, the very gaining of intellectual freedom of inquiry opened up countless fields of interest. Ethical problems sprang into existence at every turn; every new movement in industry, in politics, national and international, and in art, brought with it a new ethical problem. Social life was itself undergoing such rapid change, and in such tentative, uncertain ways, that each of these problems had to be attacked independently. The result is a critical, controversial and individualistic, rather than a constructive and systematized ethics — with the advantage, however, of remarkable richness in detail.

Continental ethics followed the prevailing philosophic method of rationalism: the attempt to build up a theory of conduct, individual and social, on the basis of pure reason, independent of revelation of ecclesiastic authority, or positive institutions. While the method was *a priori* in name, as matter of fact it drew largely upon the inheritance of generalized Roman law, attempting to harmonize and purify it in accordance with ideals of unity and comprehensiveness which were supposed to represent the demands of reason. Grotius (1583–1645) was the founder of this movement, and, in his *De Jure Belli et Pacis,* used the idea of law which is founded upon man's rational nature, which in turn is inherently social, to place international relations of comity, commerce and war upon a more humane and enlightened basis. His German successors, Puffendorf (1632–94), Leibnitz (1646–1716), Thomasius (1655–1728), Wolff (1679–1754), carried on with greater critical acumen and more adequate philosophic instruments, the same work, and finally developed a complete system of rights and duties (called *Naturrecht* after *Jus Naturale*) applicable to all spheres of private, domestic, civil, political and international life — a *code* of morals, positive in effect, but supposed all to be drawn deductively from rational first principles. Upon the whole, the influence of German ethical rationalism was conservative; the result in fundamentals was the justification of the existing social order, purged of inconsistencies and reformed of abuses in detail. French rationalism took a different turn. It attempted a synthesis of the more basal notions of the newly arisen physical science with psychological ideas borrowed from Locke and his English successors. It was rationalistic not so much in attempting to deduce an ethical system from the conceptions of reason, as in subjecting the existing order of belief and institutions to unsparing criticism as anti-scientific. In its extreme forms it seemed to demand an abrogation of existing institutions, the erection of the same *tabula rasa* in social matters, that Descartes had postulated in intellectual, and a creation, *de novo,* by sheer voluntary action, of a new social order, aiming at universal happiness. Reason gives an ideal of society in which all men shall be free and equal, and in which economic want and misery shall be abolished, and a widely diffused intelligence and wealth shall be instituted. Pessimistic to the extreme as regards the existing order, it was equally optimistic as to the possibilities of social organization, culminating in the conception of the infinitely progressive perfectibility of human nature; thus Helvetius, 1715–1771 (De l'esprit, 1758; De l'Homme, published 1773); Diderot (1713–1784); Condillac (1715–1780); D'Holbach (1723–1789), especially 'Système Social' (1773); Condorcet (1743–1794). While German ethics had emphasized the conception of natural law which is social in nature, French thought culminated in a deification of natural rights which are individual in their import and location. Certain characteristic features of not only the French Revolution but of the thought of American publicists in the latter half of the 18th century are directly traceable to this influence.

English ethical theory received its impetus from Hobbes (1588–1679). He begins with an analysis of the make-up of the individual, and resolves the latter into a bundle of egotistic impulses, all aiming at unrestricted satisfaction. He denies the existence of any inherent social tendency, or of anything "rational" in the individual save as deliberation may be involved in the individual's efforts after satisfaction. The social counterpart of this unlimited individualism is chaos, anarchy, conflict — the war of all against all. Hence the individual's quest for happiness is self-contradictory. It is possible of fruition only within the state of absolute power which prescribes to each individual the proper sphere of the exercise of his powers. The state is thus the author and sanction of all moral distinctions and obligations. The authority of this state with respect to individuals is absolute; since the source of moral law, it cannot be subject to anything beyond itself. There are thus three strains in Hobbes' teaching. The psychological, which teaches pure egotism and hedonism; the ethical, which makes the state the source of moral values and relations; the political, which makes its authority unlimited. Each strain evoked profound and instant reaction. John Locke (1632–1704) taught that the individual has a natural right to a life of personal security, possession of property and social activity, subject only to limits of the similar rights of others, and that the state comes into existence to protect and secure these rights by settling cases of dispute or aggression, and hence is null and void when it goes beyond this province, and encroaches upon individual rights. A succession of writers, notably Shaftesbury (1671–1713); Hutcheson (1694–1747); Butler (1692–1752); Adam Smith (1723–1790), undertook a re-analysis of human nature, and endeavored to justify the presence of disinterested, benevolent impulses, of tendencies to regard the welfare of others. Cudworth (1617–1688); More (1614–1687); Cumberland (1632–1718); Clarke (1675–1729); Price (1723–1791), took up the question of the origin of moral distinctions, and tried to show that they were based not in the state but in immutable laws of reason, or upon a science as abstract and certain as mathematics; or else were made known in intuition, etc. But during these inquiries, new problems came to light, and led to a rearrangement of forces. These problems were: (1) the relation of happiness — the expression of the self-seeking tendencies of man — to virtue, the expression of his benevolent tendencies; (2) the nature of the test or standard of right and wrong; (3) the nature of moral knowledge. The first problem led in Butler to the attempt to introduce "conscience" as a third and balancing authoritative factor in human nature; and in Smith and Hume (1711–1776) to a peculiarly rich and significant theory of sympathy as a central principle through which distinctively moral sentiments are generated and whose exercise is intimately bound up with individual happiness. The second and third problems taken together lead to the conflict of utilitarianism and intuitionalism, the former holding that conduciveness to the maximum of possible happiness is the standard of right, the basis of obligation, and the source of all moral rules; this conduciveness to be determined by actual experience; the latter holding that there are moral values, which are inherently and absolutely such, without reference to consequences. Each school has a theological and a non-theological variety. Among theological utilitarians are prominent Gay (1686–1761), and Paley (1743–1805); among the non-theological Jeremy Bentham (1748–1842) outranks all the others. Without adding much that is fundamentally new to the theoretical analysis, he makes an analysis of happiness in connection with a discussion of the various impulses (or motives as he termed them) of human nature the basis of a thorough-going scheme of judicial and penal reform. Through him utilitarianism became the most potent instrument of the first half of the 19th century of social reform; conduciveness to general and equally distributed happiness being the test by which all customs, traditions and institutions were tried — and by which most of them in their existent forms were condemned.

Recent Modern. (From the French Revolution.)—The last 20 years of the 18th century signalize a turning point in the history of thought. Bentham's and Kant's chief works are dated in this period. The French Revolution, carrying into effect the naturalistic rationalism and its optimistic faith in the possibilities of the individual, compelled a reconsideration of the intellectual premises from which it set forth. The problem of 19th century ethics was to get back from the individual to the social whole which includes him and within which he functions; but to do this in a way which should take due account of the deepened significance given to individual initiative and freedom — without, that is, a return to pure institutionalism, or to arbitrary external authority. The following schools or main tendencies are easily distinguishable:

(*a*) *English Liberalism.*— In Bentham, utilitarianism, as we have seen, became a programme of social reform. The attempt to stretch an individualistic hedonism which taught that the end of desire is always the agent's own pleasure into a theory which taught that the individual should always judge his motives and acts from the standpoint of their bearing upon the happiness of all beings, brought out all the weaknesses of the theory. James Mill (q.v.) (1773–1836) strove valiantly to overcome these weaknesses by a systematic use of the principle of association, in virtue of which individual states become indissolubly connected, through punishment or commerce, with the welfare of others — the theory of "enlightened selfishness," for which Hartley (1705–1757) had previously provided the psychological machinery. His son, John Stuart Mill (1806–1873) while extending the same idea, introduced into utilitarianism two innovations, which were seized upon by his intuitional opponents as virtual abandonments of the entire hedonistic position. These were that quality of pleasure is more important than quantity, and that the individual is naturally social and so instinctively judges his own welfare from the standpoint of society, instead of *vice versa*. J. S. Mill also severely criticised the other utilitarians for their neglect of the ideal elements in education, and for neglect of the culture element in historical development. Without abandoning the individualistic basis he was much influenced by schools (*b*) and (*c*) below.

From (*b*) came the influence of Coleridge (1772–1834); Maurice (1805–1872), and Sterling (1806–1843). Bain (1818—) belongs to the same empirical and utilitarian school. Sidgwick (1838–1900) in his 'Methods of Ethics' attempted a fusion of the utilitarian standard with an intuitional basis and method.

(*b*) German rationalism culminated in Kant (1724–1804), who reduced the function of moral reason in man to a single principle; the consciousness of the moral law as the sole and sufficing principle of action. Since the claims of this principle are opposed by those of self-love — the desire for personal happiness — the presence of moral reason in us takes the form of a «categorical imperative,» or the demand that duty alone, without any influence from inclination, desire or affection, be the motive of conduct. Upon the consciousness of duty are built the ideas of freedom, God and immortality — that is, by moral action is opened to us a sphere of reasonable faith in transcendental realities which are shut to scientific and philosophic cognition. Kant brought rationalism to a turn much as Bentham had affected empiricism. Subsequent German thought attempted to overcome the formalism of Kant's bare reason making itself known only in a consciousness of obligation. Hegel (1770–1831) attempted a synthesis of the Kantian idealism with the ideas of Schiller, of Spinoza (especially through the medium of Goethe), and of the rising historical school founded by Savigny. He endeavored to show that the social order is itself an objective embodiment of will and reason, and that the regions of civil law, of family life, social and commercial intercourse and above all the state, constitute an ethical world (as real as the physical) from which the individual must take his cue. He anticipated in many particulars from the standpoint of a different method and terminology, doctrines of recent anthropology and social psychology. German moral influence has been felt in English thought chiefly through Coleridge, Carlyle (who was mainly affected by Kant's successor, Fichte, 1762–1814), and more recently, T. H. Green (1836–1882). The New England Transcendentalists were also affected by this school of thought, Ralph Waldo Emerson (q.v.) (1803–1882) giving a highly original version of it, blending it with factors of his own personality and with ideas drawn from Puritanism.

(*c*) In France, the reaction from the individualism of the Revolution was most marked. At the head of the reaction stands Comte (1798–1857), who attempted to build up a theory of ethics upon an organized social basis, similar in many respects to that of Hegel, but relying upon a systematization of sciences rather than upon philosophy, for method, his system accordingly being termed positivism. Comte sought to show how such an ethical-social science could replace metaphysics and theology, the latter in the form of a religion of humanity. He influenced G. H. Lewes and the latter's wife, George Eliot, and also John Stuart Mill.

(*d*) In the latter half of the 19th century the theory of evolution has been dominant in ethical as well as in other forms of philosophic and scientific thought. Herbert Spencer's application is the best known to English readers. It is, however, generally recognized that his fundamental ethical conceptions were worked out before he became an evolutionist, and that the attachments between his ethics and the theory of evolution are of a somewhat external character. Indeed, it is now clear that the further development of the science of ethics waits upon the more thorough clearing up of the evolutionary ideas themselves, and upon more complete application to biology, psychology and sociology (including anthropology and certain phases of the history of man) in order to supply the auxiliary sciences necessary for ethical science. Through the conception of evolution it is probable that ethics will be emancipated from the survival of the idea that it is an art whose business is to lay down rules. The practical aspect of the theory of ethics will necessarily remain (since it is theory of practice or conduct), but it will take the form of providing *methods* for analyzing and resolving concrete individual and social situations, rather than of furnishing injunctions and precepts. The coincidence of the evolutionary tendency with the growth of democracy will relieve ethics in its philosophic aspects from its dependence upon fixed values, ideals, standards and laws, and constitute ethics more and more a working method for the self-regulation of the individual and of society.

Every period of ethical theory has been associated, as we have seen, with some corresponding epoch of human development, having its own characteristic problem. Upon the whole, however, ethics has not as yet adequately outgrown the conditions of its origin, and the supposed necessity they imposed of finding something as fixed and unchanging as custom. Consequently, philosophic inquiry has been devoted to finding *the* good, *the* law of duty, etc.; that is, something unchanging, all inclusive. Even the empirical school, in its emphasis upon pleasure, has tried to find something free from conditions of development, something fixed in the sense of being everywhere and at all times the same single unchanging standard and end. Even Spencer distinguishes present ethical codes as merely relative, and anticipates a period in which evolution will reach its goal — a period in which an unchanging set of rules shall be uniformly binding. But as ethical writers become more habituated to evolutionary ideas, they will cease setting up ideals of a Utopian millennium, with only one end and law; and will devote themselves to studying the conditions and effects of the changing situations in which men actually live. Consult: Humphrey, 'Conscience and Law, or Principles of Human Conduct'; Rickaby, 'Ethics and the Natural Law' (1900); Ming, 'Data of Modern Ethics Examined' (1901). JOHN DEWEY,

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Ethio'pia (Gr. α'ιθω, to burn, and δψ, countenance), the biblical CUSH, in ancient geography, the name originally given by the Greeks to the southern parts of the known world. It is divided in the poems of Homer into eastern and western Ethiopia, and this distinction is repeated by Herodotus, and by the later Greek and Roman geographers. Homer gives the southern limit of Ethiopia as the northern boundary of the Southern Sea. Some ancient writers give the boundaries of the three Ethiopian kingdoms, Meroë, Aksum, and

Napata. Eastern Ethiopia appears to have included southern India, whose inhabitants were called Ethiopians from their color. There were also other Asiatic Ethiopians, an equestrian race, of a darker color than their neighbors, who wore crests made of the hides and manes of horses, and are supposed to have been a Mongolian tribe which had wandered into the steppes of Koordistan. The name Ethiopia was more usually and definitely applied to the country south of Libya and Egypt, between the Red Sea on the east and the desert of Sahara on the west, and embracing the modern regions of Nubia, Sennaar, Kordofan, and Abyssinia. In a still narrower sense, the designation was restricted to the province or kingdom of Meroë, which was also called the civilized Ethiopia. African Ethiopia, which is called in the Bible the land of Cush, embraced, according to Pliny, 45 distinct kingdoms; yet as neither the Greeks nor Romans ever penetrated beyond Napata, in lat. 19° N., we are indebted for most accounts of it to Greek imagination. Meroë, between the Nile and the Astaboras, formed the most powerful kingdom, and had a theocratic constitution. The other principal divisions were the Blemmyes, whose aspect was hideous; the Troglodytæ, who lived in caverns; the Macrobii, or long-lived men; the Ichthyophagi, or fish eaters; and the Creophagi, Chelonophagi, Elephantophagi, Struthophagi, and Ophiophagi, respectively the eaters of flesh, tortoises, elephants, ostriches, and serpents. Fable placed also in this region the race of pygmies. Some parts of Ethiopia were named from their productions; as the land of cinnamon, and of myrrh, and the Jews and Phœnicians went thither to obtain aromatics and ivory. The Ethiopian kings seem to have been chosen from among the priests, and the order of succession gave the crown to the nephew of the king, the son of his sister; and in default of an heir, an election was made. The people practised circumcison, and embalmed their dead in a manner similar to that of the Egyptians. They were of an intrepid, impetuous, and violent character, and yet are represented as loving and practising justice. Homer makes Jupiter visit them, and sit at their feasts. There were many Ethiopian queens named Candace, one of whom became subject to the Emperor Augustus. Under the Romans the population of Ethiopia became almost wholly Arabian, and so continued after the introduction of Christianity in the 4th century. When the followers of Mohammed overran the entire region some centuries later, the Arabic element gained complete predominance in it. During the Middle Ages the Christians and clergy of Abyssinia were designated as the Ethiopian Church.

Language and Literature.— Of the different dialects spoken in modern Abyssinia, the Amharic and the Tigré are the most remarkable. The former of these shows little affinity with the ancient language of the country, the Geez, or the Ethiopic properly so called, which since the beginning of the 14th century, when a dynastic change made the Amharic the language of the court, has ceased to be the vernacular, and is used only by people of education and learning, in religious and civil documents. This ancient language, which has its name from the inhabitants calling it *lesana geez,* that is, language of science, as it is also called language of books, is of Semitic origin, resembling in roots, structure, and grammatical forms, the ancient South Arabian dialect of the Himyarites, which since Mohammed has disappeared from the peninsula. This favors the hypothesis of some historians, who suppose the Ethiopians to have been a colony from Arabia. The alphabet also of the Geez greatly resembles that of the Himyarites, as found in their remaining inscriptions. It consists of 26 consonants and 7 vowels, which are small marks inseparably connected with the former, thus forming a peculiar syllabic mode of writing, analogous to the Devanagari and some other Indian alphabets. Few of these letters show a resemblance to the Phœnician alphabet, while 24 of them may be traced in the Arabic. There are no diacritical marks; the single words are separated by two dots; the accent is difficult; the mode of writing is from left to right, the reverse having been the practice before the introduction of Christianity into Abyssinia. In roots, and forms of expression and construction, the Geez is poorer than the Arabic. According to Gesenius, one third of all the roots can be traced distinctly in the Arabic, and many other words may be presumed to be of the same origin, while the roots of others can be found in the Hebrew, Syriac, or Chaldaic, some being native African, a few of Greek, scarcely any of Coptic derivation. The Geez has 10 conjugations, 8 of which answer to those of the Arabic, the 5th and the 6th being peculiar. A double infinitive is used substantively, this mood having both an absolute and constructive form. There is no participle. The dual is unknown both in verbs and nouns; the difference of masculine and feminine is observed throughout in the second and third persons. The relation of the genitive is expressed by an inflection, causing some changes in the terminations, or through the relative pronoun; the dative by prepositions; the comparative and superlative degrees by particles. The plural is formed by affixed syllables, *ân* in masculine, *ôt* in feminine nouns, on the principle common to the Hebrew, Arabic, and Aramaic, or by changes in the radical letters, after the manner of the so-called broken plural in Arabic. In the formation of nouns the Geez most resembles the Hebrew, but it has superfluous final vowels, modified in certain cases, in which it is analogous to the Arabic in its nunnation. Beside a few fragments in inscriptions, there are no remnants of the ancient Ethiopian literature of a period preceding the introduction of Christianity under Constantine the Great, but of works composed since that time about 200 are known to European scholars. The Old Testament, translated from the Septuagint by unknown Christian writers in the 4th century, is extant in manuscripts in Europe, but only a part of it has been printed. The Psalms were published in Ethiopic and Latin by Ludolf (Frankfort 1701), and in Ethiopic alone (London 1815). The version of the New Testament appeared at Rome in 1548, and in the London polyglot Bible. Of versions of apocryphal books, in which the Ethiopic is particularly rich, several have been published, as the 'Book of Enoch,' translated by Richard Laurence into English (2d edition, London 1833), and by Hoffmann into German (Jena 1838), in *Vatis,* translated by Laurence into Latin, and published in both languages (Oxford 1819). Geez in 1840 (London), and

Ascensio Isaiæ. The 'Didascalia, or Apostolical Constitution of the Abyssinian Church,' was published in Ethiopic and English by Platt (London 1834). The *Synaxar* contains lives of saints, martyrologies, and the hymns of the Ethiopian Church, in rude rhythmical form, every three or five lines often ending in the same consonant, which forms a kind of rhyme. The profane literature of the Ethiopian language is comparatively poor, consisting chiefly of chronicles, which appear to be of considerable interest, but have not yet been generally accessible. Of these the most remarkable are the 'Keber za Nageste,' containing the traditional and legendary history of the once mighty kingdom of Aksum, a copy of which was brought to Europe by Bruce, and a translation of it appended to his travels; and the 'Tarek Nagushti,' or chronicle of kings. In Europe the Ethiopian language was almost unknown until the time of Job Ludolf, who, being assisted by an excellent native scholar, Abbas Gregorius, made himself master of it, and published an admirable dictionary and grammar (2d improved and enlarged edition, Frankfort, 1702). Manuscripts written in the Ethiopian language are in possession of Abyssinian monks and in libraries in Europe. Their knowledge of music may be inferred from their musical notation which has been published. After a long interval the interest in this language and literature has been revived by the works of Platt, Laurence, Gesenius, Hupfeld, Hoffmann, Rödiger, Ewald, and others, as well as by the contributions of Isenberg, Blumberg, and D'Abbadie. Consult: Hoskins, 'Travels in Ethiopia'; Bruce, 'Travels in Abyssinia'; Bosset, 'Etudes sur l'histoire d'Ethopie'; Bent, 'The Sacred City of the Ethiopians.'

Ethiopian Church. See ABYSSINIAN CHURCH.

Ethiopian Region. See ZOÖGEOGRAPHY.

Ethiopic Writing. See ETHIOPIA.

E'thiops Mineral, a name formerly given by chemists to the black sulphide of mercury, prepared by rubbing mercury and sulphur together, either hot or cold. *Æthiops martis,* or ethiops of iron, was the black oxide got by exposing iron-filings and water to the air. Vegetable ethiops is the plant bladder-wrack, heated until it becomes black, a remedy for scrofula.

Eth'moid Bone, The (so called from *ēthmos,* "a sieve"), is one of the eight bones which collectively form the cranial box. It is of a somewhat cubical form, and enters into the formation of the cranium, the orbits, and the nasal fossæ. Its upper surface is perforated by a number of small openings (whence its name). See NOSE.

Ethnog'raphy, a branch of ethnology, the vast science which treats of mankind as a whole, their origin and their development in language, art, religion, and political ideas, from barbarism into civilization. The German scientists class ethnology as a science standing midway between natural history and philosophy. As natural history, in the ordinary sense of the term, is a classification and description of the lower animals, ethnology may fairly be considered as a classification of the various families of the human race, based on the observation of their physical characters, and geographical distribution. From the earliest records and monuments of mankind we find traces of various types of humanity. The statues and paintings of ancient Egypt represent several racial types including the negro, the Berber, and the Asiatic. In the first book of Moses, mankind are divided according to their descent from one of the three sons of Noah, Shem's progeny occupying Western Asia, while to the posterity of Ham and Japhet fell North Africa, and Southern Europe, respectively. Some recognition of the superficial physical differences observable in variously distributed races may also be found in Greek and Roman writers. In the Middle Ages little progress was made in ethnography. The discovery of America, with its revelation of new human types, seems to have given the first genuine stimulus to this study, and the word ethnography was first used in a book published at Nuremberg in 1791, and entitled 'An Ethnographical Picture Gallery.' In his great work, 'Systema Naturæ,' Linnæus classes mankind (*Homo sapiens*) together with the apes under the order of *Primates,* and divides them into four groups, as American, European, Asiatic, and African. Buffon in his 'Variétés dans l'espèce humaine' distinguishes the races according to their geographical distribution, though he makes some reference to physical variations. Blumenbach was the first to classify the races of men according to the shape of their skull. The Caucasian, whose skull was symmetrical, he set, as the normal type, midway between the Mongolian with the square skull, and the negro with his prognathous skull, while the American was ranged between the Mongolian and the Caucasian, and the Malayan between the Caucasian and the negro. In each of these types he distinguished and recognized as important the character of the hair, the setting of the eyes, and the form of the mouth.

The modern science of ethnography dates from the year 1829 when Milne-Edwards wrote to Thierry, with the result that the Société Ethnologique was founded. The founding of an ethnographic museum was suggested by Jomard in 1843, and built some years later in Paris. Since that time the study has been thoroughly systematized all over the world. While of all ethnographical classifications the most obvious is the enumeration of the white, yellow, red, and black-skinned races, as together making up mankind, this is clearly insufficient, as it would be likely to confound widely different types. Many attempts at a more scientific classification have been made. Oscar Pechsel recognized seven races of men: (1) the Australian; (2) the Papuan, including the Melanesian, the Negrito, etc.; (3) the Mongolian, including the Polynesian, the Malay, the Eskimo, and the American Indian; (4) the Dravidian (southern India and Ceylon); (5) the Hottentot and Bushman; (6) the negro; (7) the Mediterranean races, or Caucasian, which include the Hamitic, Semitic, and Indo-European.

It will be seen that these divisions are based upon other considerations than those of physical character, for it is merely because of their geographical proximity that the Hamitic, which includes the inhabitants of North Africa, can be placed in one category with the Caucasian. Among the most recent systems of ethnographical classification is that of Haeckel who has divided the human family into races in accordance with the variations of a single physical character; that namely of the hair. According to his authority there are two main species and four sub-species of hair found among mankind, who may be broadly separated into the woolly-haired (Ulotriches), and the straight-haired (Lissotriches). The woolly-haired consist (1) of the crested-haired (Lophocomi) subdivision, represented by the Hottentot, and the Papuan; and (2) of the fleecy-haired (Eriocomi) which includes the negro and the Kaffir. The straight-haired are sub-divided into the streaming-haired, and the curly-haired. To the former belong the Australian, the Arctic dwellers, the American Indian, Malay, and Mongolian; to the latter the Dravidian, the Mediterranean races, and the Nubian.

Ethnology, that branch of the science of anthropology which treats of the races of mankind and seeks to explain their origin and development.

Anthropology is the science which treats of man in relation to himself, to other men and to all nature. It is subdivided into several branches, each of which treats of some special phase of man's natural history. There is a difference in the meaning given by students to the names employed to designate the divisions of the study of man. Ethnology, ethnography, and anthropology have been to some extent interchangeable terms. Each of these branches of knowledge has a special meaning given it in different countries. However, there is becoming a more general acceptance of a definite meaning for these topics. The comprehensive term anthropology is recognized in its general sense to include all others (Keane, Tylor, Mason). The meaning herein given to Ethnology is widely recognized (Keene, Brinton.) The use of the term anthropology, to designate societies for the study of man and for sections in national scientific bodies on both sides of the Atlantic, indicates a general tendency to accept the proper meaning of the word.

Ethnology differs from ethnography, which deals chiefly with the collection of facts regarding the families, tribes and races of mankind, in seeking to explain the significance of the information obtained: Ethnography (from ἔθνος; a people, γράφειν, to write) is a writing about, a description of, peoples. Ethnology (from ἔθνος a people, λόγος, a discourse), attempts to interpret the facts gathered, to explain the causes for the conditions and the relationships of different peoples. Ethnography and ethnology occupy a relation to each other somewhat akin to that of geography and geology. One deals chiefly with existing facts; the other attempts to interpret the history which brought them forth.

Broca says ethnography studies peoples, ethnology races. The following seems a convenient scheme for grouping the branches of anthropology. Substantially it is as follows: Archæology, Biology, Psychology, Ethnology, Ethnography, Philology, Technology, Sociology, and Religion (Mason).

The unity of the race is now generally accepted. From the researches of the physiologist, the anatomist, the philologist and the psychologist we obtain the same testimony as to the specific unity of our race. The place of origin or centre of dispersal is not fixed. From the studies of eminent specialists, it would seem that the land about the shores of the Mediterranean, or the region farther eastward toward India, may claim to be the home of primitive man. About the Mediterranean they settled down like frogs about a pond (Plato).

For classification, mankind is divided into groups. On account of their distribution, these are sometimes named for geographical divisions. They are also distinguished as families, clans, tribes, nations, peoples and races. In the naming of the latter, family relationships form a prominent factor. It is with both of these lines of classification and the distribution of those discussed under them that ethnology has to do.

In these efforts at classification, different schemes have been tried. It is generally accepted that there are two groups of elements of characterization, which are sometimes called criteria. These are physical elements and psychical elements.

The principal physical elements are the bones, the shape of the skull, the facial angle, the color of the skin, color, shape and texture of the hair. Of these, color, probably because the most conspicuous feature, was the first to be considered and formed the basis of all the early classifications. The craniological school founded by the elder Retzius (1796–1860), made the shape of the head the basis of classification, and introduced exact methods into this branch of the subject. This was based on the relative length and breadth of the skull, and accordingly mankind was divided into long-skulled, and short, broad-skulled races. Later developments in craniology introduced a third class, representing a mean between the other two. Craniology alone cannot be depended upon to supply sufficient or trustworthy materials for the proper classification of mankind. Nevertheless it has thrown much light upon the subject. Of late years the color, shape and texture of the hair have steadily risen in the estimation of naturalists as a racial test. The hair is now regarded as the most constant of all the physical features, and has been made the foundation of their groupings by some of the most eminent anthropologists.

The other physical ethnical elements are of little value separately, but are often useful aids in combination with others. Such are stature; the shape, color and position of the eye; the size and form of the brain; the shape of the nose and mouth; the superciliary and zygomatic arches, and all such other elements as collectively constitute the broad, flat features of the lower, the oval and regular faces of the higher races.

The psychical elements are less conspicuous, and have but recently been taken into account in classification. It has been said that "Love and hunger rule the world." The former relates to the perpetuation of kind, the latter to self preservation. Around these two may be grouped the other factors of this class. The following are the principal psychical elements:

(1) Preservative instinct, food, clothing, shelter; (2) Perpetuating instinct; (3) Language; (4) Religion; (5) Government; (6) The Arts.

Food, clothing and shelter are the imperative needs of the human species at all ages and under all conditions. Among the prominent topics considered under the sexual impulse are the position of woman, the marriage relation and the line of descent. Language is the chief of the psychical elements. Some perhaps, with Horatio Hale, would make it the sole test of race. The power of religion, both as a constructive and dispersive force, is the repeated testimony of history. The organization and administration of government, whether in its primitive form or in the more enlightened stage, is of deepest interest. The arts of life find their origin in the rude homes of early man, and have steadily been influential in all human progress. For these have lives been lost, tribes been destroyed, nations been formed, battles been won. They have been the motive power in every effort, the impulse behind every forward movement of mankind from the earliest days to now.

GENERAL ETHNOGRAPHIC SCHEME.

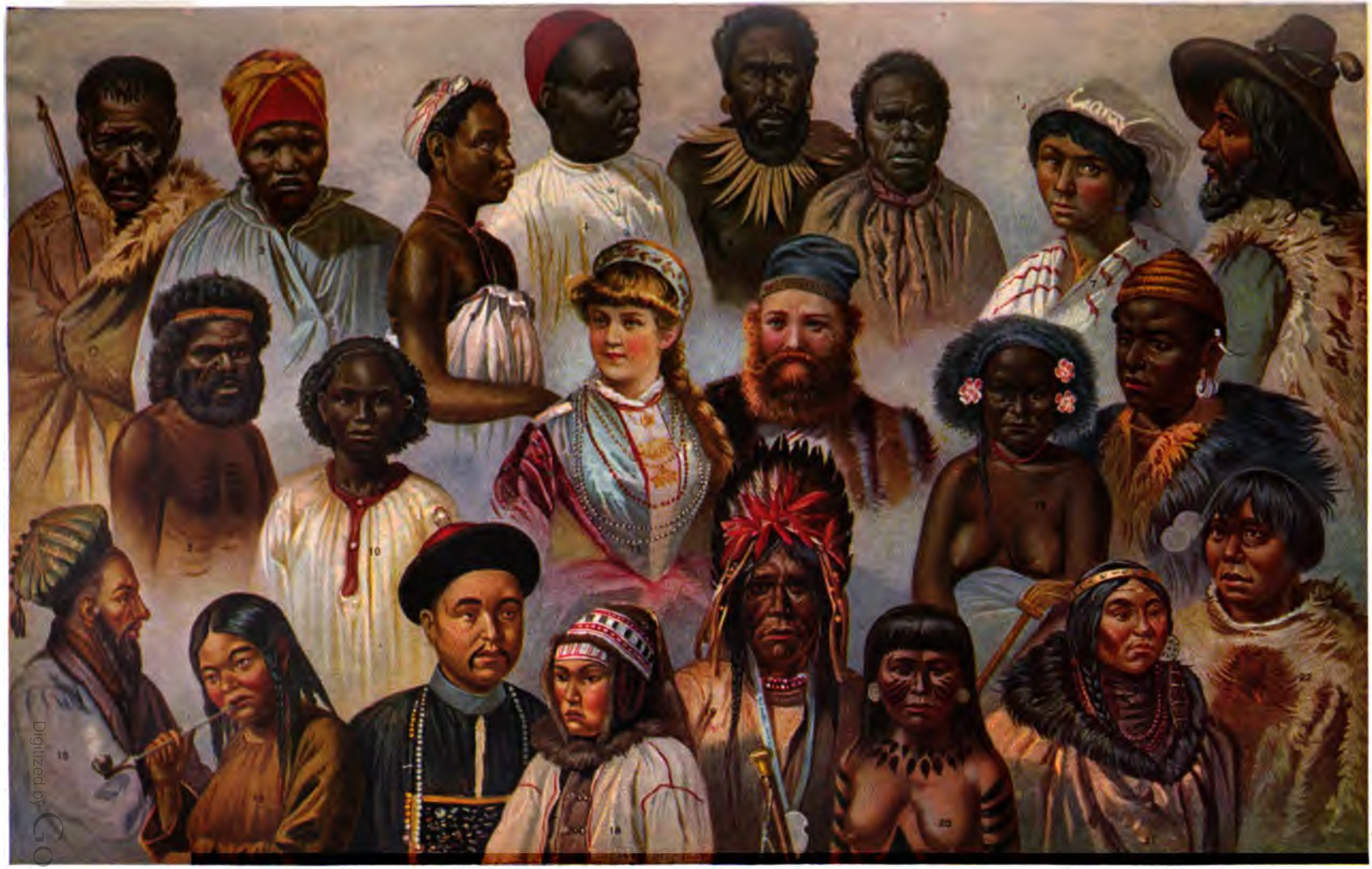
Race	Traits	Branches	Stocks	Groups or Peoples
European	Color white Hair wavy Nose narrow	I South Mediterranean	1. Hamitic	1. Libyan 2. Egyptian 3. East African
			2. Semitic	1. Arabian 2. Abyssinian 3. Chaldæan
		II North Mediterranean	1. Euskaric	Euskarian
			2. Aryac	Indo-Germanic or Celtindic peoples
			3. Caucasic	Peoples of the Caucasus
African or Negro	Color black or dark Hair frizzly Nose broad	I Negrillo	1. Central African	Dwarfs of the Congo
			2. South African	Bushmen, Hottentots
		II Negro	1. Nilotic	Nubian
			2. Sudanese	
			3. Senegambian	
			4. Guinean	
		III Negroid	1. Bantu	Kaffirs and Congo tribes
Asiatic or Mongolian	Color yellow or olive Hair straight Nose medium	I Sinitic	1. Chinese	Chinese
			2. Tibetan	Natives of Tibet
			3. Indo-Chinese	Burmese, Siamese
		II Sibiric	1. Tungusic	Manchus, Tungus
			2. Mongolic	Mongols, Kalmucks
			3. Tartaric	Turks, Cossacks
			4. Finnic	Finns, Magyars
			5. Arctic	Chukchis, Ainos
			6. Japanic	Japanese, Koreans
American	Color coppery Hair straight or wavy Nose medium	I Northern	1. Arctic	Eskimos
			2. Atlantic	Tinneh, Algonkins, Iroquois
			3. Pacific	Chinooks, Kolosh, etc.
		II Central	1. Mexican	Nahuas, Tarascos
			2. Isthmian	Mayas, Chapanecs
		III Southern	1. Atlantic	Caribs, Arawaks, Tupis
			2. Pacific	Chibchas, Quichuas
Oceanic	Color dark Hair wavy or frizzly Nose medium or narrow	I Negritic	1. Negrito	Mincopies, Aetas
			2. Papuan	New Guineans
			3. Melanesian	Feejeeans, etc.
		II Malayic	1. Malayan	Malays, Tagalas
			2. Polynesian	Pacific Islanders
		III Australic	1. Australian	Australians
			2. Dravidian	Dravidas, Mundas

There have been so many changes in this world of ours and so many mixtures of ancestral strains that it is impossible to determine certainly to which race certain peoples belong. After successive efforts by able students to classify mankind upon this or that character or group of characters, the tendency now seems to be to return to the earlier classification. To recur to the three greater subdivisions — white, black and yellow; or, Caucasian, Negro, Mongolian.

With all the data gathered and the characters used in succeeding classifications, the original color plan in a general way is as good as we know. Popularly, too, this seems to have struck the fancy. Without thought we speak of a person as white, black or red, as he is a Caucasian, Negro or an American Indian.

Dall divides man into three groups: white, black, and yellow. Flower and Lydekker also assign all representatives of mankind to three primary divisions. The status of the American aborigines is left unsettled. Keane gives to these a place among the races, making four. Linnæus in his day adopted four primary divisions. He, however, recognized man as a distinct genus, *homo*, having four species: *Homospæthiopicus, Homospmongolicus, Homospamericanus, Homospcaucasicus.* Gerland divides mankind into six races, separating the Dravidians from the other groups. To-day man is considered a single species, having several varieties or races. Blumenbach gives five groups, classified according to the color of the skin. Prof. Huxley also designated five groups along somewhat similar lines. Morton used the skull as a basis of

RACES OF MANKIND



Bushman: 1. Bushman (after *Fritsch*).—2. Namaque woman (after photograph, *Fabri*). **Negroes**: 3. Loango-woman (after Doctor *von Falkenstein*).—4. Man from Darfur (after photograph, *Hagenbeck*). **Negritos**: 5. Man from the New Hebrides (after *Godeffroy*).—6. Woman from Tasmania (from a photograph, *von Bülow*). **Black-Haired Races**: 7. Italian woman (from life). 8. Italian (from life). **Australoids**: 9. Man from Southwestern Australia (after photograph, *von Bülow*).—10. Nubian woman (after photograph, *Hagenbeck*). **Blond Races**: 11. Danish Girl (from a photograph).—12. South Russian (from a photograph). **Polynesians**: 13. Girl from the Tonga Islands (after *Godeffroy*).—14. Dyak from Borneo (after *Dammann*). **Mongoloids**: A. 15. Tarantsha-Mongol (after *Prschewalskij*).—16. Kalkas-Mongol woman (after *Prschewalskij*).—B. 17. Chinaman (after portrait, Museum of Ethnology, Berlin).—18. Yakut-woman from the Cheta (after *Middendorf*).—C. 19. North Am. Indian (after photo).—20. South Am. Indian (after *Rohde*). **Eskimo**: 21. Koriak woman (from "Peoples of Russia").—22. Eskimo from Greenland (after photograph, *Hagenbeck*).

classification; Haeckel and Broca the hair; and Hale language.

To one who carefully goes over the different schemes of classifying man, it is apparent that none is wholly satisfactory. Each in some direction overlaps some other. It is by taking all these race criteria so far as they are of value that the most reliable conclusions may be drawn as to the proper classification of mankind. No one set of standards will properly answer. That classification will be most satisfactory which obtains the most help from all the elements. All that we can aim to do is to group under some general and loose fitting subdivisions those members of the species which display the greatest number of similarities. (Brinton.) Perhaps it will be as satisfactory to follow the plan of Linnæus and classify the races of men according to geographical areas. Under such a plan we speak of the European race, which in ancient times was confined to Europe and adjacent parts of Asia and Africa; the African race, whose natural home is Africa; the Asiatic race, which is chiefly confined to Asia; the American race, composed of those occupying the western continent before its occupation by Europeans; and, the Oceanic or Australian race, comprising the tribes of Polynesia, Australia and the many groups of islands sometimes included in Oceanica. We can use Blumenbach's scheme of dividing them according to the color of the skin. Under it, they are grouped as follows:

1, Caucasian, or white; 2, Ethiopian, or black; 3, Mongolian, or yellow; 4, American, or red; 5, Malay, or brown. Dr. D. G. Brinton enumerated five races of mankind. Their chief characteristics may be summed up substantially as follows: I. The European Race — Traits — Color white, hair wavy, nose narrow, jaws straight, skull variable, languages inflectional, religions ideal. II. The African, or Negro Race — Traits — Color black, hair woolly, nose flat, jaws protruding, skull long, language agglutinative, religions material. III. The Asiatic, or Mongolian Race.— Traits — Color yellowish or brownish, hair straight, nose flat or medium, jaws straight, skull broad and high, languages isolating or agglutinative, religions material. IV. The American Race — Traits — Color coppery, hair straight, nose narrow, jaws straight, skull variable, language incorporating, religions ideal. V. The Oceanic Race — Traits — Color dark, hair lank or wavy, languages agglutinative.

Classified in this manner, the human species presents the subdivisions shown in the scheme on the opposite page.

Of the South Mediterranean branch of the European race there are given two divisions, the Hamitic and the Semitic. The former is divided into three groups, the Libyan, Egyptian and East African. The Libyan group extends over northern Africa from the Atlantic Ocean to the Nile. Some of these tribes are very dark and have been termed «Black Caucasians.» Nevertheless, except for color, they are fine representatives of the white race. The Egyptian group is represented by the ancient Egyptians and their descendants, the modern Fellah of the Nile valley and the Copts. These two groups of this branch of the European race have been potent factors in the world's history. The development of the earliest seats of culture, the organization of government, and the establishment of high degrees of civilization have been the work of their representatives. On the contrary the East African group is represented by a number of tribes who are chiefly nomadic and occupy the territory south of the Egyptian group and extending from the Nile to the Indian Ocean. They include the Gallis, Somalis and Agaas.

The Semitic stocks are made up of three groups — the Arabian, Abyssinian and Chaldæan. The most prominent of the first group are the Arabians; the existing tribes best known are the Ishmaelites and Bedouin. They have occupied at different times parts of the Arabian peninsula and now practically cover it all.

The Abyssinian group is supposed to have originated in the region last mentioned and to have been dispersed over Abyssinia and adjacent parts of Africa. They have become mixed with adjoining tribes and a corrupt form of Christianity exists among them. The Abyssinians, Tigre and Amhara are prominent nations. The former is best known.

The third group of Semitic peoples has been called the Chaldæan. This includes the Syrians, Israelites, Samaritans, Babylonians and Jews. They also originated in Arabia and spread out into other lands. The Jew has become world-wide in his dispersal. From these peoples great nations were developed and from them two great religious leaders, Jesus Christ and Mohammed, have sprung.

The North Mediterranean branch is divided into three divisions. They are the Euskaric, Aryac and Caucasic stocks. The only surviving remnant of the Euskaric stock is the Basques of Spain. That they formerly were more widely distributed is generally believed. Their relationship with other peoples is not satisfactorily determined. The most extended and most important of these race stocks is the Aryac. The origin of the Aryans has been a fruithful theme of discussion in recent years. While there is still a difference of opinion on this subject, the majority of writers have accepted the theory of their European origin. The Aryac or Indo-Germanic stock is divided by Brinton into eight groups: Celtic, Italic, Illyric, Hellenic, Lettic, Teutonic, Slavonic and Indo-Iranic groups.

The Lettic or Lithuanian peoples, while comparatively inconspicuous, are in some respects the most interesting of their fellows. They are thought by some students to be the remnant of the original stock and that which most resembles it. They are located along the Baltic Sea in Prussia and Russia.

The Indo-Iranic group is of special interest because it has the farthest eastern range and for the reason that it is nearest the region which those who believe in the Asiatic origin of the race think was its primitive home. The term Iranic is derived from the plateau of Iran, which has been thought by some to be the area of dispersal of the race. The group divides into two divisions, the Iranic, whose old representatives were the Bactrians and Persians. To-day it includes the modern Persians, the Parsees, generally known as fire-worshippers, and the tribes of Beluchistan, Afghanistan and neighboring regions. The Indic branch comprises the peoples occupying India. The most prominent of these are the Hindus, Rajpoots and Djats. The typical Brahmins probably are the best representatives of the stock.

The Teutonic group includes the Germans, English, Norwegians, Swedes and Danes, and their ancestors, the Goths, Vandals, Angles, Saxons, Norsemen. These independent, aggressive, progressive races have been conspicuous in the history of the past and the activities of the present. They have spread throughout the world as missionaries of business, education or religion. They are the forces which operate in all progressive government and are destined to sway the world.

East of these is the Slavonic group. It is represented to-day by the Russians, Poles, Czechs, Bulgarians, and other tribes of the Danube region. Of their ancestors known in history are the Scythians and Massagetæ. The Slavonic tribes to the east, in one direction, came in contact with the Indo-Iranians and, in another, with some of the branches of the Mongolians. Within comparatively recent times some of them have made remarkable progress in civilization. Russia now ranks as one of the great world powers.

The Hellenic group comprised the ancient Greeks and their relatives. They occupied at an early date the peninsulas of Asia Minor, Greece, the southern part of Italy and contiguous territory. The progress of Greek culture is familiar. Greek language, literature and art form the basis of education everywhere. Their dominion was one of the world's greatest confederacies. Overthrown by the Romans and subsequently by the Mohammedans, they were for generations hidden from the view of the progressive world. The Illyric stock is situated near the Greeks in Turkey. It is represented by the Albanians. The Italic stock covered most of the Italian peninsula. The Umbrians, Etruscans, Oscans and Latins were the principal older representatives. They developed the Roman empire and in the organization and conduct of government and the framing of laws they achieved a front place in the history of the world.

The Celtic group, originally spread over western Europe, has largely disappeared. Certain parts of the British Isles and the north of France contain the surviving members. These are the Irish, Welsh, Scotch, Manx and the people of Brittany.

The Caucasic stock is represented by four groups: Lesghic, Circassic, Kistic and Georgic. They occupy the Caucasus Mountain region.

The African race occupies Africa south of the Sahara desert and of the Nile valley. It is classified in three groups: the Negrillos, Negroes and Negroids. Under Negrillos (little Negroes) are grouped the Akkas and other pygmies of the interior region, and the small-sized Bushmen and Hottentots farther south. The characters of some of these tribes are faithfully preserved in figures upon the Egyptian monuments. The most striking of these physical features is the peculiar growth and development about the pelvic region. The clicks of the Hottentot and Bushman languages find no counterpart in any other tongue. The Negroes are confined chiefly to western and central Africa, ranging east into Nubia. They comprise four subdivisions: the Nilotic, Sudanese, Senegambian and Guinean. The first is confined to the upper Nile valley. The Sudanese group is represented by tribes in Sudan and westward. The western coast south of the Senegal River is the territory of the Senegambians. Farther south toward the Niger River are the tribes of the Guinea group. This region was the chief source of the slave trade. The descendants of the Guinea negroes found throughout the United States are living witnesses of the slavery which existed there but a generation ago.

The Negroids approach the Negroes, but are in some ways quite different from them. Their color is brown rather than black; their hair is "kinky" but not woolly; the nose is straight and not short and flat. They are of two groups — the Nubian and Bantu. The former are found in Nubia and the upper Nile valley. The latter occupies practically all of southern Africa except the region of the Hottentots and Bushmen. Among the better known tribes are the Kaffirs, Bechuanas and Zulus. The African race occupies a low stage in culture. It has developed in the restricted area south of the Sahara basin. Probably it reached its typical development in the Niger valley.

The Asian, or Mongolian race is made up of two divisions — the Sinitic and Sibiric. The Sinitic branch includes the Chinese, Tibetans and the inhabitants of Anam, Siam, Burma and Cochin China. The Chinese have occupied their territory from quite early times. They have developed a peculiar civilization and in some particulars reached quite a high stage of culture. While there is considerable difference of opinion whether the arts of ancient China developed there or were acquired from the Aryans to the westward, it seems probable that in a great measure at least, they were indigenous.

The Sibiric branch of this race is largely located north of the mountains of Central Asia, ranging with the Arctic Circle from the Pacific to the Atlantic Ocean. The six groups are the Tungusic, reaching from northern China toward the Arctic Ocean and to Kamchatka. The Mongolic occupying the vast highlands west of Manchuria. Genghis-Khan and later Tamerlane established two of the wide extended Mongol empires. The Tartaric, another highland group, has spread from Turkestan in several directions. The Turk is the most conspicuous representative, though much mixed with other races. The Finnic is a group of Mongols occupying northern Europe. It is represented there by the Finns and Lapps and farther south by the Magyars. From there it extends east to the Volga River. The rude tribes fringing the Arctic Ocean in eastern Siberia and reaching to the Pacific are grouped under the name Arctic. The Chukchis and Kamchatkans are of their number. The Japanese and Koreans constitute the Japanese group. The Japanese are the most progressive and advanced of the Asiatic race.

The Oceanic race may be divided into three stocks — Negritic, Malayic and Australic. It occupies Australia, the islands of the South Pacific and Indian oceans, and the adjacent shores of Asia. In their migrations, whether along the shores or over the seas, they have so intermingled that their relationships are puzzling. The Negritic stock is represented by the Negritos, including such small peoples as the Mincopies of the Andaman Islands, the Papuans of New Guinea and other islands, and the Melanesians. The Malayic stock is the most conspicuous and energetic of the ocean peoples. Its representatives are found extending almost two thirds around the world, reaching from Easter Island to Madagascar. The most typical Malays are found in Malacca, Sumatra and Java, while others less marked extend from the Celebes to the Philippines. The Malays farther to the eastward are often called Polynesians. From their traditions it has been possible to obtain a fairly good idea of their successive migrations and of the comparative time of the settlement of the different island groups. They extend from New Guinea to New Zealand, Easter and the Sandwich islands. The Australic stock includes the different tribes of Australia, the extinct Tasmanians, and, according to some authorities, the primitive peoples of the peninsula of Hindustan. The Australians are very low in culture, nomadic, lacking government and wear little or no clothing. «The life of these savages proves to be of undeveloped type, alike in arts and institutions, so much so, that the distinction of being the lowest of normal tribes may be claimed for them.»—(E. B. Tylor.)

The American race includes those peoples occupying the western continent at the time of its discovery by white men. For the purpose of study they may be divided into seven groups: Arctic, North Atlantic, North Pacific, Mexican, Inter-Isthmian, South Atlantic, South Pacific.

The Arctic group includes the Eskimo and Aleutian peoples. They occupy the shores of the oceans in Arctic America, and extend from Labrador to Greenland. In the North Atlantic group are some Indians of wide range. The Athabascans extend from the valleys of the Yukon and lower Mackenzie, to Arizona, while farther to the southward reaching into Mexico, the warlike Apaches are of this group. The Algonkins ranged from Newfoundland to the Rocky Mountains and from the Churchill River valley and Hudson Bay southward throughout the Ohio and Mississippi valleys to the Tennessee River. These included most of the Indians encountered by the early settlers. Their names are more or less familiar to us from history. The intelligent Iroquois, the formidable Dakotas, (Sioux), the southern Indians, some of whom built mounds within historic times, and the tribes of the interior plains also belong to this division. The North Pacific group includes a number of tribes west of the Rocky Mountains, many of which are small and represent distinct linguistic stocks. Several of these tribes have the head artificially deformed. These include the Flatheads and Nez Percés (Pierced Noses). The Cliff-dwellers and Pueblo tribes of the arid regions of the southwestern United States are placed here. The Mexican group is notable because of the state of civilization attained by the Aztecs, its best known tribe. The organization developed, government established, education acquired, buildings constructed and arts pursued were unequaled by any tribe of the American race. The Mayas were the most important tribe of the Inter-Isthmian group. They were builders of note, elaborate decorators of stone, and mural artists. The South Atlantic group occupied the Atlantic coast of South America. They were chiefly wandering tribes without settled habitations. The Quichuas of Peru are the best known tribe of the South Pacific group. They attained higher civilization than any other South American tribe. They developed agriculture, domesticated animals, constructed large buildings of stone, were expert workers in metals, and devised a method of record keeping by means of strings and knots called quippus. See Keane, ‘Ethnology’; Brinton, ‘Races and Peoples’; ‘The American Race’; Gerland, ‘Ethnography’; Tylor, ‘Anthropology.’

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Ethyl, the organic radical C_2H_5, which occurs in many carbon compounds, but which cannot exist in the free state. Its most important compound is ethyl hydrate, or ethyl alcohol (see ALCOHOL); but the iodide, C_2H_5I, which is formed by acting upon ethyl alcohol with iodine in the presence of phosphorus, is also of much importance in synthetic chemistry.

Eth'ylam'ine, an amine (q.v.) in which one or more of the hydrogen atoms of ammonia, NH_3, is replaced by the radical ethyl, C_2H_5. Three compounds of this sort are possible, and all have been actually prepared. When only one of the hydrogen atoms of the ammonia has been replaced, the resulting compound, $NH_2.C_2H_5$, is known as mono-ethylamine, or ethyl monamine; and it is this substance which is understood when the word ethylamine is used without qualification. $NH.(C_2H_5)_2$ is known as diethylamine, and $N.(C_2H_5)_3$ is called triethylamine. All three are formed when absolute alcohol is heated with zinc chloride, in closed tubes, to 500° F.; and they may then be separated by the crystallization of their picrates. Ethylamine (that is, the mono-amine) may also be prepared by boiling cyanic ether with an aqueous solution of caustic potash, absorbing the liberated gas by passing it through hydrochloric acid, and finally drying the ethylamine hydrochloride that is so formed, and distilling it with quicklime. All three of the ethylamines are alkaline, all smell of ammonia, and all combine with acids to form salts. The mono-amine is a colorless, inflammable liquid, having a specific gravity of 0.70, boiling at 68° F., and not solidifying at 220° below zero, F. Diethylamine (which may be prepared by heating the mono-amine with ethyl bromide) is also volatile, colorless, and inflammable, with a specific gravity of 0.72, and boils at 133° F., under ordinary atmospheric pressure. Triethylamine is very similar to the other two in general character. It has a specific gravity of 0.73, boils at 194° F., and its critical temperature (according to Pawlewski) is 513° F. (See CRITICAL POINT.) Triethylamine is but slightly soluble in water; diethylamine dissolves in water freely; mono-ethylamine mixes with water with a considerable rise of temperature, and the probable formation of a hydrate; though it is entirely expelled again, upon boiling.

Eth'ylene, a gaseous hydrocarbon having the formula C_2H_4, and constituting the first member of the olefine series. It is formed in the dry distillation of numerous organic bodies, but is most conveniently prepared for laboratory purposes by mixing 1 part of alcohol with 4 parts of sulphuric acid, adding enough sand to form a paste, and heating the mass over a flame. The sand takes no part in the chemistry of the process, but merely serves to regulate the action. The sulphuric acid, owing to its affinity for water, removes the elements of water from the alcohol, and thereby liberates the ethylene, $C_2H_5.OH = H_2O + C_2H_4$. Ethylene is a colorless gas, which burns with a bright flame, a five-foot burner, using the pure gas, yielding a light of 68 candle-power. It may be condensed to a transparent liquid which boils, under ordinary atmospheric pressure, at 153° F. below zero, and freezes at 272° F. below zero. Ethylene is an unsaturated compound, and combines directly with hydrogen when mixed with that gas and led over platinum black; the product of the combination being ethane, C_2H_6. Mixed with three times its own volume of oxygen, and fired by a spark, ethylene explodes with great violence. When it is mixed with chlorine in the dark, combination takes place according to the formula $C_2H_4 + 2Cl = C_2H_4Cl_2$, the new substance being an oily fluid, known as ethylene dichloride, or «Dutch liquid.» It is on account of this reaction that ethylene was formerly called «olefiant» (or «oil-forming») gas. It will be observed that the foregoing reaction is an additive one. In diffuse daylight chlorine attacks the dichloride of ethylene, with the formation of more highly chlorinated substitution products, of which the highest is C_2Cl_6.

Etienne, Charles Guillaume, shärl gē yōm ā-tē-ĕn, French dramatist: b. Chamouilly 6 Jan. 1778; d. Paris 13 March 1845. Under the first empire he was censor, editor-in-chief of the ‹Journal of the Empire,› and a member of the Academy; at the Restoration he was expelled from the Academy, and thereafter as editor of the «Constitutional» was a power on the side of the opposition. His comedies give proof of brilliant fancy, elegant style, and great constructive skill; ‹The Two Sons-in-Law› is the best comedy of the Imperial Era, and not unworthy of Molière. He composed many farces, vaudevilles, operettas, and spectacular pieces, which had unbounded success; and his operas, ‹Cinderella› and ‹Joconde,› were the delight of Paris. He wrote a ‹History of the French Theatre.›

Etienne du Mont, ā-tē-ĕn dü môṅ (Fr. «Saint Stephen of the Mount»), a fine church of mediæval Paris. It was founded in 1220; its completion and restoration were begun in 1517, and the building reached its present perfection in 1626. The shrine of Saint Genevieve, heroine and patron saint of Paris, is its principal point of antiquarian interest, but it is also the burial-place of Pascal and Racine.

Etiolation, ē″tĭ-ō-lā′shŏn, the alteration in the color and the structure of plants due to the absence of light during growth. The most noticeable changes are paleness and elongation of the stems. The elongation is due to the extension of the cells, and the paleness to the non-development, arrested development or destruction of the chlorophyll or green coloring matter of the plant. Other phenomena are imperfect development of leaves, altered method of branching, and various modifications of tissues, especially in the imperfect development of the cell-walls, which do not attain normal thickness. Agriculturally, etiolation is either a fault to be shunned or a useful process. In the first case it is often responsible for the «lodging» of wheat and other grain-crops sown too thickly, the bases of the stems being shaded so much that the cells fail to develop normal strength, and when the heads form the wind easily beats down the plants. The sprouting of potatoes, turnips, etc., is also undesirable. But etiolation is utilized in the blanching of various plants, such as asparagus and sea-kale, and especially salads such as celery, endive, and chicory. The process involves the exclusion of light by means of earth banked around the stems, by boards, paper, etc., or by tying the outer leaves loosely over the inner ones as with endive or with cauliflower. Rhubarb is often grown in darkness. In general, tenderness and modifications in flavor are the chief ends sought in the process.

Etiquette, ĕt′ĭ kĕt, a collective term for the established ceremonies and usages of society. Among courts the Byzantine and Spanish courts, and the French court under Louis XIV. and Louis XV., were noted for the strictness of their etiquette. Social etiquette consists in so many minute observances that a tolerable familiarity with it can be acquired only by a considerable intercourse with polite society. Quickness of sympathy and a certain fineness of observation are more needed for proficiency in this sphere than mere power of intellect.

Etive, ĕt′ĭv, **Loch,** an inlet from the Firth of Lorne, on the west coast of Scotland. The scenery of its shores is very beautiful. About three miles from the sea, at Connel Ferry, a ridge of sunken rocks crossing it causes a turbulent rapid, which at half-tide forms a sort of waterfall. Salmon and other fish are plentiful.

Etlar, Carit, pseudonym of KARL BROSBÖLL, Danish realistic novelist: b. Friderica 7 April 1816. His first story was ‹The Smuggler's Son› (1839); of his later writings, the historical tale of ‹The Queen's Captain of the Guard› and the realistic story ‹The People in Need› (1878) are the most popular; his verse also has merit. An edition of his collected works was published 1859–68; with an additional collection in 1873–9; a new edition appeared in 1888.

Et′na, or **Ætna,** a volcano in the eastern part of the province of Catania, on the island of Sicily, and the largest active volcano in Europe. Directly north is the valley of Alcantara, on the west and south, the valley of Simeto, and on the east, the Ionian Sea. From the waters on the east Etna rises cone-like to a height of about 10,875 feet; but on the south and west it seems formed of superimposed mountains, the terminal being surrounded by a number of cones, all of volcanic origin, about 100 of which are of considerable size. The circumference at the base is about 100 miles. Around the mountain and on the lower slope are a number of villages, cultivated fields, groves of olive-, orange-, fig-, and date-trees; and a little higher up is a belt of forest with oak, birch, beech, and coniferæ. Above 7,000 feet vegetation is scanty, the cone is almost bare; rocky precipices, lava beds, masses of ashes and scoriæ are visible at its summit except where covered by snow. A deep depression, Val de Bove, on the eastern side, was once the principal crater; and frequently lava has issued out of the sides of the mountain, thus forming small cones and craters, about 200 of which are now distinctly marked. From the summit may be seen the whole of the island of Sicily, the Lipari Islands, Malta, and Calabria. The eruptions of Etna have been numerous and many of them destructive; more than 80 have been recorded, 11 of which occurred before the Christian Era. That of 1169 A.D. overwhelmed Catania and buried 15,000 persons in the ruins. In 1669 the lava spread over the country for 40 days, and 10,000 persons are estimated to have perished. In 1693 there was an earthquake during the eruption, when over 60,000 lives were lost. One eruption was in 1755, the year of the Lisbon earthquake. Among more recent eruptions are those of 1852, 1865, 1874, 1879, 1886, 1892. An eruption is ordinarily preceded by premonitory symptoms of longer or shorter duration. In Greek mythology there are found frequent allusions to Etna, especially in the legends of Enceladus and Hiphæstus. Consult: Dana, 'Characteristics of Volcanoes'; Kneeland, 'Volcanoes.'

Etna, Pa., borough in Allegheny County, on the Allegheny River, the Pittsburg & W., the Etna & M., and a branch of the Pennsylvania R.R.'s. It is really a suburb of Pittsburg, with only the Allegheny River between. The chief industries are in connection with the iron and steel products for which this part of the State is famous. Pop. (1910) 5,830.

E'ton, England, town, in the county of Buckingham, on the Thames, 22 miles west of London. It consists principally of one narrow street, which has of late years been much improved. An iron bridge across the Thames connects Eton with Windsor, from which it is separated only by the river. Eton derives its celebrity from its college. Pop. 3,309.

Eton College is one of the famous English public schools, and was founded by Henry VI. in 1440, under the name of "The College of the Blessed Virgin Mary Beside Windsor." The present collegiate edifice was begun in 1441 and the whole of the original structure was completed about 1523. Important additions were made in 1846, and also in 1889. This school was intended originally for the benefit of the sons of worthy but poor parents, and also for the support of 25 poor infirm men; and was to be maintained out of the incomes from the royal demesne lands. Now the students admitted are the sons of the gentry and nobility, and so numerous are the applicants that it is usual to enter the names at birth. The scholarships are open to all British subjects; but candidates must be 12 years or over and not more than 14 years, and must pass an examination. A certain number of the students, not under 17 years, are elected each year to scholarships at King's College, Cambridge. The number of pupils on the foundation is limited to 70, but the number outside, called oppidans, who board and lodge in the houses of the masters, is about 1,000. The course of instruction is mainly classical, but the modern languages, mathematics, and the natural sciences are given now a due share of attention. Consult: Cust, 'Eton College'; Lyte, 'History of Eton College' (1440-1898).

Etorofu, ā'tō-rō-foo, or **Iturup,** ē-too-roop', (1) an island; (2) a strait; in the most northerly part of Japan. The island belongs to the Kurile group.

Etruria, ē-troo'rĭ-ạ (Greek *Tyrrhenia*), the name anciently given to that part of Italy which corresponded nearly with the modern Tuscany, and was bounded by the Mediterranean, the Apennines, the river Magra, and the Tiber. The name Tuscia, for the country, came into use in late times, while Tusci, as well as Etrusci, was used by the Romans as the appellation of the people from an early period. The oldest inhabitants of the country belonged, according to the accounts of the ancients, to the Umbrian stock, and were dispossessed by the Tyrrhenians or Tyrsenians, a people who came by sea, and who were generally believed to be Lydians. These again were in early times subjected by another race who called themselves Rasena, and who finally became incorporated with the Tyrrhenians proper, the whole nation then being called Tuscans or Etruscans. These Rasena, by ancient writers usually confounded with the Tyrrhenians, entered Italy at a very early period from the north, and gradually took possession of the whole country from the Alps, Ticino, and lower Adige on the south.

To what race the Etruscans belonged is unknown, and our ignorance is equally great with regard to their language, remains of which still exist in numerous inscriptions mostly on tombs. It appears to have been quite distinct from the languages of the rest of Italy, but attempts to connect it with the Greek, Celtic, Germanic, or Semitic languages have had little or no success. The characters used are essentially the ancient Greek, and were either introduced from Magna Græcia or possibly from Corinth. Etruria was very early a confederation under the rulers of the 12 principal cities, each of which formed a republic by itself. The chiefs of these republics were styled *lucumones*, who were also the priests and generals, and held their meetings in the temple of Voltumna, where they deliberated together on the general affairs of the country. In all the cities there appears to have been an aristocracy, toward which the mass of the common people stood in the relation of clients, though there would no doubt be a body of entirely free men resembling the plebeians at Rome. The religion of the Etruscans offers a subject of great difficulty, but it is at least certain that it had many points in common with the religious systems of the Sabines and Latins, while in some respects it shows evidences of an Eastern origin. Among the deities may be mentioned Tina or Tinia, corresponding to the Latin Jupiter; Cupra, corresponding to Juno; Menerfa (Minerva); Sethlans (Vulcan); Turms (Mercury); and Aplu or Apulu (Apollo).

The chief occupations of the Etruscans were agriculture and commerce, both maritime and overland. Grain, wine, timber, cattle, and wool seem to have been the principal articles of trade. The staple food of the common people was pulse, but the upper classes were notorious for extravagance in their diet as well as in dress and in furniture. Their knowledge of the arts and sciences is said to have been derived mainly from Greece, and in a less degree from Egypt. The iron mines and copper mines in the interior of Etruria were worked at a very remote period, and the metallurgical skill shown by the Etruscans was obviously connected with their proficiency in the art of working in bronze, silver, gold, etc. Of Etruscan architecture our knowledge is limited. The so-called Tuscan order seems to be little else than a modification of the Doric. Of their temples there exist no traces; the theatres have been more fortunate, that at Fiesole showing how much in this form of construction they owed to the Greeks. The sepulchres, which were always subterranean, but frequently having superstructures of an architectural character surmounting them, present many varieties of construction.

For articles in terra-cotta the Etruscans were especially celebrated. These were not restricted to small objects, but embraced statues and figures of large size, with which the exteriors and interiors of their temples were adorned. Closely related to this branch of art was the Etruscan pottery, in the manufacture of which they excelled; but the only extant productions of this class that can be said to be genuine are the red ware of Arretium and the black ware of Clusium ornamented with figures in relief, many of them of a grotesque and strongly marked Oriental character. On the other hand, numbers of the painted vases popularly known as Etruscan vases, are undoubtedly productions of Greek workmen, the subjects, the style, and the inscriptions being all Greek. The skill of the Etruscans in works of bronze is attested by many ancient writers, and also by numerous extant specimens. The style of art characteristic of these works is stiff and archaic, having some resemblance to the early Greek, though some of the existing specimens exhibit more freedom of design and great beauty of execution. The bronze candelabra, of which many examples have been preserved, were eagerly sought after both in Greece and Rome. Another branch of art which seems to have been peculiar to this people was that of the engraved bronze mirrors, a considerable number of which has been discovered, some quite recently. These mirrors were polished on one side, and have on the other an engraved design, taken in most cases from Greek legend or mythology. Consult Dennis, 'The Cities and Cemeteries of Etruria' (1892).

Etruria, Kingdom of, the name given to the province of Tuscany, in Italy, when, in 1801, Napoleon formed of it a kingdom, and made Florence the capital. In 1808 he incorporated it with the French empire, and in 1809 his sister, Elise Bacciocchi, was made grand duchess of Tuscany. The country came under the control of Ferdinand III., when Napoleon became an exile in 1815.

Etruscan Vases, a class of beautiful ancient painted vases made in Etruria, but not strictly speaking a product of Etruscan art, since they were really the productions of a ripe age of Greek art, the workmanship, subjects, style, and inscriptions being all Greek. They are elegant in form and enriched with bands of beautiful foliage and other ornaments, figures and similar subjects of a highly artistic character. One class has black figures and ornaments on a red ground — the natural color of the clay; another has the figures left of the natural color and the ground painted black. The former class belong to a date about 600 B.C., the latter date about a century later, and extend over a period of about 350 years, when the manufacture seems to have ceased. The subjects represented on these vases frequently relate to heroic personages of the Greek mythology, but many scenes of an ordinary and even of a domestic character are depicted. The figures are usually in profile.

Ettlingen, ĕt'lĭng-ĕn, Germany, town in the grand duchy of Baden, on the Alb, five miles south of Carlsruhe. It is an ancient place, containing some Roman remains; is entered by three gates, and has an old castle with gardens, town-house, hospital, normal and other schools, manufactures of linen and cotton goods, starch, leather, and paper. Pop. 8,156.

Ettmüller, Ernst Moritz Ludwig, lood'vĭg ĕt'mül-lĕr, German philologist and historian: b. Gersdorf, Saxony, 5 Oct. 1802; d. Zürich 15 April 1877. He made extensive researches in German mediæval literature and was author of 'German Dynasty Founders' (1844); and other epic poems, besides the 'Anglo-Saxon Lexicon' (1852).

Ettrick, ĕt'rĭk, a district of Scotland, in Selkirk, through which the Ettrick water runs. It is now a sheep pasture, denuded of wood, but in ancient times it formed part of Ettrick Forest, which included the whole county as well as parts of Peebles and Edinburghshire. The "Ettrick Shepherd," James Hogg, was a native of this district.

Ettrick Shepherd, The. See HOGG, JAMES.

Ettwein, ĕt'vīn, **John,** American Moravian bishop: b. Trendenstadt, Würtemberg, 29 June 1721; d. Bethlehem, Pa., 2 Jan. 1802. He came to America in 1754, and for nearly 50 years worked among the Moravians as evangelist, pastor, and bishop. He traveled thousands of miles, oftentimes on foot, preaching in 11 of the 13 colonies and in what is now the State of Ohio, "in cities, in villages, in homesteads, from pulpits, in the open air, in court-houses and barns, to many and very different classes of men," as he himself wrote. Among the Indians, too, he worked with great success. In 1776–7 he rendered noble service to the sick and wounded of the American army in the general hospital at Bethlehem, Pa. Elected bishop in 1784, he presided over his church for nearly 17 years, displaying the soundest judgment in matters of polity, and a fine personal heroism in critical circumstances. In 1787 he founded the Society for Propagating the Gospel Among the Heathen, which still exists, richly endowed, and is the bulwark of the extensive Moravian mission work. He became proficient in the language of the Delaware Indians, prepared a dictionary and phrase book of it, and in 1788 compiled an account of the language with a vocabulary, which has since been published by the Pennsylvania Historical Society. Old age compelled his retirement from active service in 1801.

Et'ty, William, English painter: b. York 10 March 1787; d. there 13 Nov. 1849. He worked long without much recognition, but at length in 1820 won public notice by his 'Coral Finders.' In 1828 he was elected an academician. Among his works, which were greatly admired, are a series of three pictures (1827–31) illustrating the 'Deliverance of Bethulia by Judith'; 'Benaiah one of David's Mighty Men'; 'Women Interceding for the Vanquished.' All these are very large pictures, and are now in the National Gallery of Scotland. Others of note are: 'The Judgment of Paris'; 'The Rape of Proserpine'; 'Youth at the Prow';

and ‘Pleasure at the Helm.’ In coloring and the representation of the nude he displayed high ability.

Etymologicum Magnum (Gr. «the great etymological glossary, or dictionary»), the sole lexicon of size surviving from the Byzantine age of Greek learning. It is evidently a compilation from other works of the same class, and bears no author's name. The book may be attributed to the 10th century. It consists of a number of quotations from the works of ancient grammarians, arranged alphabetically. It may have received its name from its first critical editor, Sylburg, or from its printer, Calliergus. The book is of high philological value, although many of the derivations of words contained in it are fanciful and utterly unscientific.

Etymology (Gr.), the investigation of the origin or derivation and of the original signification of words. It forms a subsidiary part of the science of comparative philology, and, though it has occupied the attention of the learned and the curious in every age, it is only within the 19th century that its study has been pursued on really scientific principles. Ignorance, or what is still more dangerous, half-knowledge, has often suggested false etymologies, and many more have sprung from that excess of confident and self-sufficient ingenuity which will not take plain words like *beef-eater* and *welsh-rabbit* for what they are. Folk-etymology properly so called, has played an important role in the development of languages. The words that the people have known from infancy are for them things, but it is quite different with the new terms they meet. These arrest their curiosity, and, as they believe that every word has its signification, they seek for this, guided by resemblances of sound with words already known, and consequently reach conclusions often hopelessly distorted by false analogies. We see the same illogical process in the Old Testament interpretation of personal names, applied conveniently after the fact; in the Homeric explanation of the names of gods and men; in the quaint etymologies so common in the mediæval writers, and in such moderns as Thomas Fuller; in the vagaries of Celtic topographers; and even in the pages of some modern dictionaries it is possible to find such a statement as that the English word *news* is derived from a certain conjunction of the points of the compass, north, east, west, and south. These whimsical etymologies were laughed at by Dean Swift, whose *ostler* = *oatstealer*, was a stroke of genius, but have not yet disappeared; and, indeed, the modern ideas of method in etymology are hardly at all beyond the point attained by the grammarians of Alexandria and by Varro among the Romans. It was the birth of philology and the study of the languages of the East that made a scientific etymology possible. It no longer sought the relations of the words of a single language exclusively within itself, but extended its view to the whole group of cognate tongues, or, wider still, to a whole family, and became a new science under the name of Comparative Grammar. Grimm's Law was the first finger-post that pointed out the path; among his greatest successors are Curtius and Fick. The Teutonic revival in England in the 19th century commenced the history of English upon an historical method, from which has grown a really scientific English etymology, as seen in the dictionaries of Prof. Skeat and Dr. Murray. No more useful chart of warning could be given than the former's canons for etymology: «Before attempting an etymology, ascertain the earliest form and use of the word, and observe chronology. If the word be of native origin, we should next trace its history in cognate languages. If the word be borrowed, we must observe geography and the history of events, remembering that borrowings are due to actual contact.» See Curtius, ‘Grundzüge der Griechischen Etymologie’ (1879); Fick, ‘Vergleichendes Wörterbuch der Indo-germanischen Sprachen’ (1874–6); Palmer, ‘Folk-Etymology’ (1882); also see SCIENCE OF LANGUAGE.

Eu, ė (Lat. *Auga*), France, town in the department of Seine-Inférieure, two miles above the mouth of the Bresle; 17 miles northeast of Dieppe. It was in the castle belonging to this place that William the Conqueror married Maud of Flanders. The town was burned to the ground in 1475, by order of Louis XI., to prevent it from falling into the hands of the English. It has several small manufacturing establishments. Pop. 5,412.

Eua, ā-oo'ä, a small island belonging to the Friendly Islands, owned by Great Britain; area, about 125 square miles. The climate of all the islands of the Tonga group, to which the Friendly Islands belong, is but slightly higher than that of the Samoan Islands, just north.

Eubœa, ū-bē'ạ, formerly called NEGROPONT, a Greek island, the second largest island of the Ægean Sea. It is 90 miles long, 30 in greatest breadth, reduced at one point to four miles. It is separated from the mainland of Greece by the narrow channels of Egripo and Talanta, and is connected with the Bœotian shore by a bridge. There are several mountain peaks, one over 7,000 feet. The island is well wooded and remarkably fertile. Wine is a staple product, and cotton, wool, pitch, and turpentine are exported. The chief towns are Chalcis and Karysto. The island was anciently divided among seven independent cities, the most important of which were Chalcis and Eretria, and its history is for the most part identical with that of those two cities. With some small islands it forms a modern nomarchy, with a population of 103,442.

Eubulides (ū-bū'lĭ-dēz) **of Miletus,** Greek philosopher: the best known of the disciples of Euclid of Megara, flourished about the middle of the 4th century B.C. His life was a struggle against Aristotle, in which by a captious logic he sought to prevail against good sense. A partisan of the Megaric principle, that there is nothing real but what is always one, simple, and identical, he immediately found an adversary in the founder of the great contemporary school which made experience the condition of science. He attacked the peripatetic doctrine, like Zeno of Elea, by striving to show that there is none of our experimental notions which does not give place to insolvable difficulties.

Eubulus, ū-bū'lŭs, Greek comic writer: fl. at Athens about 375 B.C. His subjects were chiefly mythological, and many of his plays contained parodies of the tragic poets, especially Euripides.

Eucaine. See Cocaine.

Eucalyptus, ū-kạ-lĭp'tŭs, a genus of trees and a few shrubs of the natural order *Myrtaceæ*. The species, of which there are about 140, are characterized by simple unsymmetrical leaves, whose edges usually turn toward the sun; generally white, bell-shaped flowers, sometimes solitary, but commonly in terminal or axillary umbels near the ends of the twigs; calyx-lobes joined to form a lid, which falls off when the flower opens (from this feature the genus is named); numerous stamens; and many-seeded, angular fruit-capsules. With the exception of about half a dozen species which are natives of the East Indies and the Malay Peninsula, the members of the genus are indigenous to Australasia, where they are among the most common forest trees. The various species are highly valued for planting in parks and along avenues; for the gum-resin which oozes from their trunks; for the volatile oil contained in their leaves; for the tannin obtained from their bark; for the fibre of their inner bark; and for their powers of transpiring immense quantities of water, a quality made use of in swampy districts to get rid of excessive moisture, especially when such cannot be readily removed by drainage. They have been widely distributed by man in warm climates, particularly in the British possessions. But above all these things they are valued for their timber, which is extensively used for wharf, ship, bridge, and house building, telegraph poles, railroad ties, implements, furniture, etc. To obtain it the trees are frequently ring-barked about the beginning of the warm season so as to exhaust the sap as much as possible. After standing until the end of the dry season they are felled. Some of the species are among the largest living trees of the world. Specimens exceeding 450 feet in height and with a girth of 50 feet are occasionally reported, and trees of 400 feet in height are often found.

Few species are hardy, but many are cultivated for ornament where they can be given shelter from cold winds, or where, like other tender ornamental plants, they can be removed to a house during the winter. In California a majority of the species thrive in the open air, and are valued for their striking habits of growth, their foliage, etc. They are readily propagated from seeds sown in light, sandy soil. The seedlings should be transplanted when about four inches tall, and again at rather frequent intervals, to insure the formation of fibrous roots near the surface, thus to secure them a good start when transplanted to final quarters. Transplanting should always be done in cool, moist, cloudy weather. When once established they demand no further attention than ordinary pruning and training.

Among the best known species are the following: *Eucalyptus globulus*, the blue-gum, which often exceeds 300 feet in height, has bluish or grayish smooth bark, except at the base. It is noted for its rapid growth, the unpleasantly flavored nectar of its blossoms, which are very attractive to bees, and its ability to withstand long periods of drought. It is the most frequently planted species in California, where it is also becoming naturalized by means of its seeds. It is also planted to some extent in Florida and other Gulf States, and is said to survive a temperature as low as 20° F. It is one of the most valuable of timber trees and is one of the chief sources of oil of eucalyptus. A somewhat hardier species (*E. viminalis*), popularly known as manna gum, attains about the same size, but has either dark-colored persistent bark or light-colored deciduous bark. In California, where it is also spreading like the former, it has withstood lower temperatures and made phenomenal growths, in some instances exceeding 70 feet in height and 3 feet in girth in 12 years. It is valuable for its nectar, of which bees are very fond, but its timber is less valuable than that of the preceding species, being less strong. It is frequently used for fencing, shingles, and other purposes where strain is not expected. Perhaps the most valued is *E. marginata*, the jarrah tree or wood, which often attains heights exceeding 70 feet without the development of any limbs, and at that height often has a girth of 15 feet. It is not hardy. Its wood is especially valued for wharf and ship building, since it is not attacked by the teredo or shipworm. It is also highly esteemed for underground work, such as ties and telegraph poles, and, being easily worked and polished, is popular for house finishing and furniture. The largest species is probably *E. amygdalina*, the peppermint-tree, which is also noted for its abundant yield of oil. Its timber is not strong, but is largely used for staves, shingles, building, etc. *E. robusta*, the swamp-mahogany gum, is perhaps the species most frequently planted in swampy places. Its timber is remarkably durable and is used, like that of *E. marginata*, but is somewhat less esteemed. It is one of the finest of avenue trees, and one of the best for bees because of its abundant nectar and profuse bloom.

In medicine the oil of eucalyptus is used for its antiseptic and stimulating properties. It is very widely used in affections of the nose, mouth, and bronchi, and in diseases of the bladder and urethra. It makes a very agreeable and efficient drug to add to antiseptic mouthwashes, and is useful internally as an intestinal antifermentative. Trees of eucalyptus have been planted, especially in low marshy places, with a belief in their beneficial effects against malaria. It is frequently asserted that they have a direct action on malaria. By the aid they furnish in converting marshes into dry land they also help to prevent the development of mosquitoes, some forms of which are known to be the chief agents in the spread of malarial disease. (See Malaria; Volatile Oils.) Consult: Bailey 'Cyclopedia of American Gardening' (1900–2); Mueller, 'Eucalyptographia'; Bentham, 'Flora Australiensis,' Vol. III.; Pepper, 'Eucalyptus in Algeria and Tunisia, from an Hygienic and Climatological Point of View' (Proceedings of the American Philosophical Society, Vol. 35, pp. 39–56); Cooper, 'Forest Culture and Eucalyptus Trees.'

Eucharis, ū'kạ-rĭs, a genus of plants of the natural order *Amaryllidaceæ*, the species which, mostly natives of Colombia, are perennial herbs with perennial bulb-like rootstocks, broadly ovate leaves, and very showy white flowers in umbels upon long, strong scapes. They are very popular hot-house plants because of their beauty and the prolificacy of their long-lasting flowers. They are easily grown in coarse fibrous soil which will permit of abundant watering

Forest Cover for Parks, Los Angeles, California.

Avenue Shade Trees, near Santa Monica, California.

without danger of stagnation. Partial shade and rather high temperature are also needed. The best-known species is probably *E. grandiflora*, which is popularly known as star-of-Bethlehem and Amazon lily. The flowers of this species are borne upon a scape often exceeding 18 inches in height and bearing two to four star-like and very fragrant flowers, often four inches in diameter.

Eucharist, ū'kā-rĭst, in the Roman Catholic Church, the sacrament of the body and blood of Jesus Christ, and also the Christian covenant sacrifice. Regarding the Eucharist as a sacrament the Roman Catholic Church teaches that it is the true body and blood of Jesus Christ under the «species» or appearances or physical properties of bread and wine. The institution of this sacrament by Christ is recorded in the three synoptic gospels and in St. Paul's first letter to the Corinthians. The name given to the sacrament comes from the expression in the original Greek text of Luke xxii. 19, ἐυχαριστησας (eucharistesas), «having given thanks.» The words of institution, as given by the same evangelist, are: «This is my body which is given for you. . . . This is the chalice, the new testament in my blood, which shall be shed for you.» The perpetuation of this sacrament is commanded in the words, «This do for a commemoration of me» (1 Cor. xi. 24). A year before the institution of the sacrament Jesus Christ in a discourse at Capernaum, spoke of his flesh being «meat indeed» and his blood «drink indeed»; and it is important to note the circumstances in which he employed those extraordinary expressions. He had already said: «I am the bread of life,» at which the Jews murmured. Thereupon Jesus, instead of modifying the expression which offended them, reenforced it, saying: «The bread which I will give is my flesh for the life of the world.» At this the Jews again murmured, but Christ does but emphasize the doctrine in the words already quoted. And not only the Jews were scandalized by these speeches: many of his disciples even would no longer listen to him; they «went back and walked no more with him.» Would the apostles also desert him? and he elicited from them a profession of implicit faith in his words, however «hard» his sayings might be.

And that attitude of the apostles is the attitude of the Roman Catholic Church. Those words of her Founder and the many other announcements he made touching this sacramental mystery, the Roman Catholic Church from apostolic times has received in their plain literal interpretation — the interpretation put upon them by all who heard them, Jews, disciples, apostles, and by Jesus Christ himself: the Roman Catholic Church teaches that in the Eucharist is contained «truly, really, and substantially» the body and blood of Jesus Christ, together with his soul and divinity. Here nothing is added to, nothing taken away from, the words of Christ, and nothing explained away in those «words of eternal life.» And when in the 11th century the Church's reading of those words as denoting a «true, real and substantial» change of the bread and wine into Christ's body and blood was challenged by Berengarius, who, more «spiritually-minded» than the apostles of Jesus Christ, would fain see in Christ's words only a figurative, symbolical presence of his body and blood in the sacrament, the Roman Catholic Church adopted the fittest possible word to express the change wrought in the bread and wine — the word Transubstantiation: in the Eucharist the substance of bread and wine remain no longer underlying the outward appearances, «species» of bread and wine; what underlies them now is the body and blood of Christ. Such is the teaching of the Roman Catholic Church with regard to the real presence of Jesus Christ in the Eucharist.

But the Eucharist is not only a sacrament: it is also the perpetual New Covenant sacrifice, believed to have been foretold by the prophet Malachi, as rendered in the Vulgate, which differs slightly from the authorized Anglican version: «From the rising of the sun even to the going down thereof, my name is great among the Gentiles, and in every place there is sacrifice, and there is offered to my name a clean oblation» (Mal. i. 10–11). And the Roman Catholic Church teaches concerning the Eucharistic sacrifice or the Mass that «it is one and the same sacrifice with that of the cross: the victim is one and the same, Jesus Christ, who offered himself, once only, a bloody sacrifice on the altar of the cross. The bloody and unbloody victim is still one and the same, and the offering upon the cross is daily renewed in the Eucharistic sacrifice, in obedience to the command of our Lord, 'Do this in remembrance of Me.'» — *Catech. Conc. Trid., cap. de Eucharistiæ Sacr.*

Euchlo'rine, a name given by Sir Humphry Davy to the yellow gas obtained by acting upon potassium chlorate with hydrochloric acid. Davy believed it to be a new oxide of chlorine; but it is now known to be a mixture of chlorine and chlorine peroxide, ClO_2. It has powerful bleaching and disinfecting properties, but it is frightfully explosive, and should never be prepared nor handled save by an expert chemist, provided with proper safeguards, and with a full previous knowledge of its properties.

Euchre, ū'kėr, a game of cards, said to be of German origin, the most generally played parlor game after whist in the United States. The pack of cards consists of 24, being an ordinary «deck,» minus the deuce, trey, four, five, six, seven, and eight spots of each suit. The game is usually played by two, three, or four persons, the most interesting party being four, two playing on each side as partners. When choice of partners and first dealer shall have been decided five cards are dealt, usually two at once, then three, or the contrary. In throwing around for partners and dealers the holder of the best card deals. The cards rank in value as follows: The best euchre card is the knave of trumps; the second best is the knave of the suit of the same color as the trump. The former card is called the «right bower,» the latter the «left bower.» After the right and left bowers the cards rank as at whist, the knaves of the color not turned as trumps falling into their regular place as at whist. The object of the game is to take tricks. The score is five points, unless otherwise agreed. The non-dealer may «pass,» or «order up» the trump. Should he pass, then the dealer may take up the trump and discard. In that case the dealer must make three tricks or be «euchred,» which counts two points for the adversary, but if he makes the three tricks (or four), he counts one point. Should he make all five tricks, it is termed «a march,» and counts him two on the score. The non-dealer has the first lead, after which he who takes the trick leads. Should the non-dealer «order up» the trump he must make three tricks or be «euchred,» which counts two for his opponent, if he win three tricks (or four), having ordered up the trump, he scores one point. Should he make «a march,» he scores two. If both players pass (the dealer turning down the trump), and then both decline to make a trump, there must be a new deal. Either party naming a new suit for trump must make the three tricks or be «euchred.» In four-handed euchre the same counts are made and the same rules practised as in the two-handed game, together with the following: The opportunity to «pass,» «order up,» «assist,» or «play alone» goes around in rotation, beginning with the player on the left of the dealer. «To assist» is for the partner of the dealer to say «I assist,» which has the same effect as ordering up the trump, and is subject to the penalty of two points to the adversary, should three tricks not be secured by the party «assisting» and his partner. Either partner ordering up a trump or making a trump may «play alone,» that is, play his hand singly against the other two, his partner not playing his hand that round at all. «Progressive euchre» is played by a number of participants at separate tables, the successful players moving up in a regular order. A prize is generally awarded to the two winners.

Euchologion, ū-kō-lō'jĭ-ŏn, the liturgical and ritual book of the Greek Church, answering to the Missal, which is the Pontifical and Ritual of the Latin Church. The Uniate Greek Church, or Church of the Greek Rite in communion with the See of Rome, has a separate Euchologion.

Euclase, ū'klās, a rare gem mineral, a basic silicate of glucinum and aluminum, $HBe\ Al\ SiO_5$. It occurs in Brazil, Siberia, and Austria, in brilliant, transparent, colorless to pale-green or blue crystals of monoclinic forms, and has a hardness of 7.5.

Euclid (ū'klĭd) **of Megara,** Greek philosopher, the founder of the Megaric school of philosophy. He was a pupil of Socrates, after whose death, 399 B.C., he retired to Megara (most probably his native city) and set up a school of philosophy, in which he blended the doctrines of the Eleatic school with those of his master. He adopted the Eleatic notion of one universal unchangeable existence, and upon this he engrafted the ethical views of Socrates. From its subtlety and disputativeness, the school of Euclid was sometimes called the Dialectic or Eristic. Nothing has survived of Euclid's work and the date of his death is unknown.

Euclid of Alexandria, Greek mathematician: fl. about 277 B.C., and taught geometry at Alexandria in the reign of Ptolemy Soter, and extended the boundaries of mathematical science. The severity and accuracy of his method have never been surpassed. His 'Elements,' in 13 books, still form the most usual introduction to the study of geometry. See Geometry, Elementary Pure; Mathematics.

Eudæmonism, the doctrine that happiness (Gr. *eudaimonia*) is the chief good. Happiness, according to Aristotle, is the activity of soul in accordance with virtue, virtue being the mean between excess and defect as determined by reason. See Ethics.

Eudialyte, ū-dĭ'a-līt, a rhombohedral red mineral of vitreous lustre, translucent or nearly so; its hardness, 5.5; specific gravity, 2.90 to 3.01. It consists principally of silicates of iron, zirconia and lime. There are two varieties, eudialyte proper, of which the double refraction is positive, and eucolite, in which it is negative. It is found in North Greenland, Norway, and Arkansas.

Eudiom'eter, an instrument employed in the analysis of gaseous mixtures. It was originally designed for ascertaining the quantity of oxygen contained in any given bulk of elastic fluid. The first instrument of this kind was constructed by Priestley. In one form of eudiometer two platinum wires are inserted near the top of a graduated glass tube open at the bottom. An electric spark is introduced by these wires. The process involves the explosion and combustion of one of the constituents to be determined. The operation may be conducted in a trough of mercury or over water. See Gasometric Analysis.

Eudists, ū'dĭsts, a congregation or society of secular priests founded in the 17th century by a priest named Eudes; for the purpose of conducting ecclesiastical seminaries and giving «missions» in parish churches, for the revival of religious zeal and the conversion of sinners. The members of the society take no religious vows, but they live in common and are voluntarily subject to the orders of their superior. They do not wear any habit to distinguish them from the rest of the secular clergy. Their first house was established at Caen in Normandy 1643; the membership at that time consisted of Eudes and eight other priests. In his time Eudes conducted 110 missions in various places in the kingdom. The institute never spread to other countries. Eight or more Eudists were among the priests who were butchered in the wholesale slaughter of priests, monks and bishops at the Carmes, Paris, September 1792. The society was broken up during the French Revolution, many of the members seeking refuge in England. In 1826 the apostolate was revived and resumed with ardor and great success.

Eudocia, ū-dō'shĭ-ạ, Roman empress: b. Athens about 393; d. Jerusalem about 460. She was a daughter of Leontius the philosophical sophist. After the death of her father, who left nearly all his property to his two sons, she went to Constantinople for the purpose of complaining of this injustice to the emperor, Theodosius II. There she embraced the Christian religion, was baptized as Eudocia and became empress 421 A.D. She was afterward divorced and spent the remainder of her life in Jerusalem, engaged in acts of devotion. She is said to have written some Greek poems and also a life of Christ.

Eudoxia, ū-dŏk'sĭ-ạ, Byzantine empress: wife of Arcadius, emperor of the West: d. 409. She was the daughter of Banto, a Frankish general of Theodosius; and Eutropius, the eunuch, intriguing against Rufinus, chief minister of Arcadius, induced the emperor to take her to wife, instead of marrying the daughter of Rufinus, as the latter had designed. Eutropius soon after this union caused Rufinus to be put to death and succeeded him. Eudoxia, if we may believe John Chrysostom, was an infamous creature, although at one time winning his admiration and profuse acknowledgments by an open profession of religious earnestness. She was a woman of strong passions and resolute will, and when Eutropius insulted her by saying that as he had raised her so he could debase her, she appealed to the weak Arcadius, who at once degraded Eutropius from all his honors, and ordered his statue in the market place of Constantinople to be destroyed. Chrysostom so vehemently inveighed against the court life of Eudoxia that she caused him to be banished in 403, but popular clamor, added to the panic caused by an earthquake, induced her to recall him. But her enmity caused his second exile in 404. She survived this persecuted prelate only two years, and if she were too impatient under the almost Aristophanic invective of a bishop who was more a monk than a courtier, she was probably sincere in her anxiety to rescue the feeble Arcadius from the dominion of a minister like Eutropius, and the best act she ever did in her life was to bring this monster of profligacy and corruption to the end of his career.

Eudoxia, Roman empress. She was the daughter of Theodosius II.; b. Constantinople 422; d. about 463. She was married to her cousin Valentinian III., emperor of the West, after whose death, by the hands of emissaries of the senator Maximus, she was constrained to espouse the latter. Maximus subsequently had the folly to reveal to her the part which he had taken in the murder of Valentinian, and when the time for vengeance seemed to her to have come she invited to Italy Genseric, king of the Vandals, at whose approach Maximus was murdered. Genseric delivered Rome to pillage, and bore away with him to Africa Eudoxia and her two daughters.

Eudoxians, ū'dŏk'sĭ-ạnz, followers of Eudoxius, who from 356 A.D. was bishop of Antioch, in Syria, and from 360 to his death in 370 bishop and patriarch of Constantinople. He was successively an Arian, a Semi-Arian and an Aëtian. Respecting the Trinity, he believed the will of the Son to be differently affected from that of the Father.

Eudoxus (ū-dŏk'sŭs) **of Cnidos,** Greek astronomer, lived about 370 B.C., was the scholar and friend of Plato. All his works are lost, but the poem of Aratus on astronomy makes us acquainted with the extent of his astronomical knowledge. Eudoxus seems to have been the first to introduce an astronomical globe into Greece, and this may account for the great reputation which he acquired and long continued to enjoy.

Eufaula, ū-fâ'lạ, Ala., city in Barbour County, on the Chattahoochee River, and on the Central Georgia Railroad; 80 miles southeast of Montgomery. It is at the head of steamboat navigation on the river; is the trade centre of a large manufacturing and agricultural district; and carries on an extensive cotton-shipping trade, exporting over 30,000 bales annually. It has gas and electric lights, waterworks plant erected by the city in 1897 at a cost of $60,000, public parks, Union Female College, public high school, and three national banks. Pop. about 4,700.

Euganean (ū-gā'nē-ạn) **Hills,** a range of well-wooded hills, lying southwest of Padua, in northern Italy. They owe their origin to eruptions of trachyte during the Jurassic Period. The highest point, Monte Venda, reaches about 1,895 feet. On their slopes stand several villas, among them Petrarch's house at Arquà. Valuable building stone and mineral springs abound.

Eugène, ē-zhān, **Prince** (François Eugéne de Savoie-Carignan), Austrian general: b. Paris 18 Oct. 1663; d. Vienna 21 April 1736. Among all the generals and statesmen of Austria, none has rendered more numerous and important services than Eugène. He was great alike in the field and the cabinet. He petitioned Louis XIV. for a company of dragoons, but was refused on account of the opposition of Louvois, minister of war, who hated the family of Eugène. Indignant at this repulse Eugène, in 1683, entered the Austrian service. The distinction he earned at the siege of Belgrade in 1688, at that of Mayence in 1689, and elsewhere, procured for him rapid promotion. War having broken out between France and Austria, he prevailed upon the Duke of Savoy to enter into an alliance with the emperor, and in 1690 received the command of the imperial forces sent to Piedmont to act in conjunction with the troops of the Duke of Savoy. He defeated the Turks at the battle of Zenta (11 Sept. 1697), and obtained on that occasion the applause of Europe. The loss of the Turks at Zenta obliged them to accede to the Peace of Carlowitz 1699, which was the first symptom of their decline. In 1703 he received the command of the army in Germany; and his efficient co-operation with Marlborough frustrated the plans of France and her allies. In the battle of Höchstädt (Blenheim) 13 Aug. 1704, the two heroes gained a decisive victory over the French and Bavarian army, commanded by the Prince of Bavaria and Marshal Tallard, the latter of whom was made prisoner. In 1705 Eugène returned to Italy, where he hastened to the relief of Turin, stormed the French lines, forced them to raise the siege, and in one month drove them out of Italy. In 1707 he entered France, and laid siege to Toulon; but the immense superiority of the enemy obliged him to retire into Italy. During the following years he fought on the Rhine, took Lille, and, in conjunction with Marlborough, defeated the French at Oudenarde (1708), and Malplaquet (1709). After the recall of Marlborough and the defection of England from the alliance against France, his farther progress was in a great measure checked. The Peace of Rastadt, the consequence of the Treaty of Utrecht, was concluded between Eugène and Villars in 1714. In the war with Turkey, in 1716, Eugène defeated two superior armies at Peterwardein and Temesvar, and, in 1717, took Belgrade, after having gained a decisive victory over a third army that came to its relief. The Treaty of Passarovitz (concluded in 1718) was the result of this success. During 15 years which followed, Austria enjoyed peace, and Eugène was as active in the cabinet as he had been in the field. Consult Malleson, 'Prince Eugène of Savoy' (1888).

Eugene, ū-jēn', Ore., city, county-seat of Lane County; on the Willamette River, the Southern P. and the O. R. & N. C. R.R.'s; 105 miles west by south of Portland, and 52 miles from the Pacific Ocean. The University of Oregon, established here in 1876, had about 500 students. The manufactures are chiefly flour, lumber, and bricks, and some articles for home consumption. The city was settled in 1854. Pop. 3,561.

Eugene Aram, a novel by Bulwer-Lytton, published 1832. It was founded on the career of an English scholar, Eugene Aram: b. 1704; executed for the murder of one Clark in 1759. The character of the murderer and the circumstances of his life made the case one of the most interesting from a psychological point of view, in the criminal annals of England. Aram was a scholar of unusual ability, who, self-taught, had acquired a considerable knowledge of languages, and was even credited with certain original discoveries in the domain of philology. Of a mild and refined disposition, his act of murder seemed a complete contradiction of all his habits and ideals of life. 'Eugene Aram' is an unusually successful study in fiction of a complex psychological case. At the time of its publication, it caused a great stir in England, many attacks being made upon it on the ground of its false morality. To the present generation its romance is of more interest perhaps than its psychology. Thomas Hood's poem on the same theme is entitled, 'The Dream of Eugene Aram'; W. G. Wills' play, 'Eugene Aram,' was produced in 1873 by Henry Irving.

Eugéne de Beauharnais, ē-zhān dė bō-är-nā. See BEAUHARNAIS, EUGÈNE DE.

Eugenics. The science of eugenics is of recent origin, having gained its greatest foothold in England, where there is at the present time a Eugenics Education Society — the only one at present in existence. The new science has gained such rapid and general interest, however, that it may be said to be one of the important movements of the day.

The Eugenics Society of London, defines the new science thus: «The study of agencies under social control that may improve or impair the racial qualities of future generations, either physically or mentally.»

Eugenics consists, in fact, largely in the enforcement of judicious mating; and the debarring of those unfit to have children from marrying. Future generations, no less than those which are past, deserve our thoughtful love and consideration; indeed, Prof. Stanley Hall recently said that he considered it the most sacred trust given to man — the health and happiness of those as yet unborn, whose destiny now lies in our power.

The fundamental purpose of eugenics may, perhaps, best be summarized in the circular recently issued by the Eugenics Society of London. This says in part:

«The fact that the laws of heredity apply to man equally with the lower animals and plants, and that the mental functions are subject to the same laws of heredity, as the physical ones, has yet to be taken to heart by the public. The salutary effects of natural selection in preventing the degeneracy of a race are so largely interfered with, and sometimes even inverted, by civilization that another form of prevention is peremptorily demanded. If we apply the general word 'degenerate' to the insane, to the imbecile, to the habitual criminal, and to those who are naturally liable to some of the more serious diseases, it is found that a 'degenerate' is no less fertile than a normal person, apparently a little more so, and that such persons frequently marry. Each married degenerate produces, on the average, one child who is as degenerate as himself or herself, and others in whom the taint is latent, but liable to appear in a succeeding generation. The taint of degeneracy in our population is now alarmingly great and threatens to increase indefinitely under the present conditions. Probably one of the first efforts in practical eugenics will be to restrict the propagation of children by the notoriously unfit, whose marriages are now unhindered, if not sometimes fostered by mistaken kindliness. Efforts have been made in the opposite direction, namely, in creating social agencies that shall promote the propagation of the fit, as, for instance, by facilitating employment to married persons of good stock, and providing their families, when poor, with better housing and nurture than they could otherwise obtain. The power of public opinion being enormously great, we may rest assured that, after the importance of eugenics shall have become thoroughly recognized, many social influences will be brought to bear, and numerous customs will establish themselves that shall further eugenic conduct with a gentle yet almost irresistible force.»

The literature of the Eugenics Society has as its aim: «To make known the result of all seriously conducted investigation without bias in favor of any particular school. Its range will include: (1) *Biology* — in so far as it is concerned with heredity and selection; (2) *Anthropology* — in so far as it throws light on questions of race and the institution of marriage; (3) *Politics* — in so far as it bears on parenthood and its relation to civic worth; (4) *Ethics* — in so far as it promotes ideals that lead to the improvement of racial quality; (5) *Religion* — in so far as it strengthens and sanctifies the sense of eugenic duty.»

The science of eugenics thus insists upon bettering the hereditary influences and the environment of the child, when born. Only the best of the race should have children; and of these, the best care should be taken. Were this followed, there is no doubt but that a fine race of human beings would be existent in one or two generations. Race suicide would be abolished. We hear much of this now; but the real race suicide consists, not in a low birth rate, but because of the unscientific begetting of children, and the subsequent unscientific care and nurture of the children actually born.

A single example will show the extent of the influence of heredity and environment upon the children of «degenerates.» The secretary of the Indiana Board of State Charities, in a recent report, said:

«We have made a careful study of the history of 248 families. The whole number of persons composing these 248 families was 887, of which 562, or 63.2 per cent were mentally defective. In 101 of the 248 families under consideration has been found a history

Courtesy of the Booklovers Magazine. From the painting by Winterhalter.

EUGENIE.

of feeble-mindedness in two generations; 12 families, with 77 members, had feeble-mindedness in three generations; while two families showed four, and one five generations of this defect. Of the 447 persons in the 101 families in which mental deficiency was known to have descended from parents to children, 359, or 80 per cent, were found to be feeble-minded. In the remaining 147 families, in which feeble-mindedness has been found in but one generation, there were 440 persons, of which 203, or 46.1 per cent, were feeble-minded.»

Riddell tells us that: «Carefully compared and computed statistics from all parts of the United States indicate that about 45 per cent of our insane, 70 per cent of our criminals, 75 per cent of our prostitutes, 80 per cent of the feeble-minded, and 95 per cent of the epileptics were born from drunken, neurotic, or criminal stock.» It is well known that the children of the drunken parents are liable to become drunkards in turn. Doctor Beech says that 31.6 per cent of the offspring of drunken parents are idiotic. Darwin pointed out that, if alcoholism be continued from generation to generation, the children in time become sterile — which is nature's way of terminating the race in that direction.

Sir Francis Galton — the «Father of Eugenics» says:

«I take eugenics very seriously, feeling that its principles ought to become one of the dominant motives of a civilized nation, much as if they were one of its religious tenets. . The first object is to check the birthrate of the unfit, instead of allowing them to come into being,— though doomed in large numbers to perish prematurely. The second object is the improvement of the race by furthering the productivity of the fit by early marriages and healthful rearing of their children; natural selection rests upon excessive production and wholesale destruction; eugenics, on bringing no more individuals into the world than can be properly cared for, and those only of the best stock.»

Eugénie, é-zhā-nē (EUGÉNIE MARIE DE MONTIJODE GUZMAN Y DE PORTO-CARRERO), ex-empress of the French: b. Granada, Spain, 5 May 1826. Her father, the Count de Montijo, was of a noble Spanish family; her mother was of Scotch extraction, maiden name Kirkpatrick. On 29 Jan. 1853 she became the wife of Napoleon III. and empress of the French. On 16 March 1856, a son was born of the marriage. When the war broke out with Germany she was appointed regent (27 July 1870) during the absence of the emperor, but on 4 September the revolution forced her to flee from France. She went to England, where she was joined by the prince imperial and afterward by the emperor. Camden House, Chiselhurst, became the residence of the imperial exiles. On 9 Jan. 1873, the emperor died, and six years later the prince imperial was slain while with the English army in the Zulu war. In 1881 the empress transferred her residence to Farnborough in Hampshire. She has published 'Some Recollections from My Life' (1885).

Eugénie Grandet, ė-zhā-nē grăṅ-dâ, a novel by Honoré de Balzac. It appeared in 1833, and is included among the 'Scenes of Provincial Life.' In it, the great French master of realism depicts with his accustomed brilliant precision the life of a country girl, the only child of a rich miser.

Eugenius, ū-jā'nĭ-ŭs, the name of four popes. The first, Saint Eugenius, was elected 654; d. 657. EUGENIUS II. occupied the Roman See from 824 to 827. His election was contested by a powerful faction in the city who favored Cincinnus (Zinzinnus); and Lothaire, son of Louis le Débonnaire, who shared the empire with his father, came to Rome to quell the disturbance. On this occasion the people and clergy of Rome took the oath of fidelity to the two emperors, and promised that thereafter whenever a new pope succeeded he should, before his consecration, take oath in presence of the people and the emperor's representative to honor the emperor as the protector of the Church. The Pope was the first to take this oath; its terms were complied with at the two papal elections next following, for example, of Valentinus who filled the see three months and of Gregory IV. EUGENIUS III.: b. Pisa; d. Tivoli 7 June 1153. He was a Cistercian abbot and a close friend of Saint Bernard of Clairvaux and was elected 1145. Before his consecration the populace of Rome, led by Arnold of Brescia, effected a revolution and overturned the papal government; during a reign of a little more than eight years Eugenius was most of the time in exile, living at Viterbo, Siena, and other places in Italy and in France. EUGENIUS IV.: b. Venice 1383; d. Rome 23 Feb. 1447. He was a Celestine monk, cardinal, and bishop of Siena when he was elected successor to Martin V. 1431. On 23 July 1431 was opened the Council of Basel, convoked by his predecessor; but not one bishop was present for the opening, only theologians, abbots and canons. On 12 November the Pope ordered the council to be dissolved and convoked another council to be held in 1433 at Bologna; but the fathers of the council of Basel continued to hold their sessions; throughout his reign the Pope was in conflict with the council. From first to last the council sought primarily and almost exclusively to curb the authority of the Roman See, and in consequence there passed between Rome and Basel a succession of bulls ordering the dissolution of the council, annulling its acts, anathematizing its members; and from the other side decrees of the council declaring that general assembly of the Church to be superior in authority to the Pope, and finally a decree proclaiming Eugenius deposed and setting up as Pope Amedeo, Duke of Savoy, who assumed the style Felix V. This was the act of the council in its 35th session held 8 July 1439. At the same date there was assembled at Florence, at the call of Eugenius, a council attended by 160 Latin and some 20 Greek bishops, with the Emperor John Palæologus; at this council a reconciliation was effected between the eastern and western churches; but it stood only till its terms and conditions became known in the East, when it was repudiated by the Greek Church. The cause of the rival Pope Felix was at this time fatally weakened by the withdrawal by the emperor Sigismund of his support and by his declaring for Eugenius.

Eugubine (ū'gū-bĭn) **Tables,** the name given to seven bronze tables found in 1444 at the town of Gubbio, the ancient Iguvium or Eugubium, now in the Italian province of

Perugia, bearing inscriptions in a language decided to be that of the ancient Umbrians. These tables are the most important monument of the language in which they are written. Four are inscribed in Umbrian characters, two in Latin, and the remaining one partly in Umbrian and partly in Latin. The contents of the tables refer to the ritual of the priests of the Temple of Jupiter. Photographic reproductions of the inscriptions, with translations, are given in Bréal's 'Les Tables Eugubines' (1875–8).

Euhemerism (ū-hē'mē rĭzm), or **Euemerism.** See MYTHOLOGY.

Eukairite, ū-kā'rīt, a rare mineral of a shining lead-gray color and granular structure, consisting chiefly of selenium, copper, and silver. Its name is derived from the Greek word meaning *opportune,* and was given to it by Berzelius because found soon after the discovery of selenium.

Eulachon, ū'lă-kŏn, or **Candle-fish.** See CANDLE-FISH.

Eulalia, ū-lā'lĭ-a, Spanish virgin martyr: b. Merida, Estremadura; d. 12 Feb. 308 A.D. When she was only 12 years old, the great persecution of Diocletian was set on foot, whereupon the young girl left her maternal home, and, in the presence of the Roman judge, cast down the idols he had set up. She was martyred by torture.

Eulalia, a popular name for certain species of tall perennial ornamental grasses of the genus *Miscanthus* (natural order *Gramineæ*). They are natives of eastern and southern Asia. The best-known species is probably *M. sinensis,* which has developed several well-marked horticultural varieties characterized by green, mottled or striped foliage and large terminal fan-like panicles of flowers, which, after shedding their deciduous parts, are still attractive because of their persistent silky hairs, which give the panicle a delicate, fluffy appearance for which they are valued as house decorations and for everlasting bouquets. Because of their beauty, their perfect hardiness, and the ease with which they can be propagated by means of seeds or division of the roots, these plants are universal favorites, especially for bedding purposes.

Eulenburg, oi'lĕn-boorg, **Botho,** German statesman: b. 31 July 1831. In 1867 he was elected to the North German Reichstag as a Conservative; became minister of the interior in 1878 and as such formulated the famous Socialist law of October 1878. Differences with Bismarck led to his resignation of this office 1881. In 1892 he succeeded Count Caprivi as president of the Prussian ministry, but owing to controversies between Eulenburg and Caprivi over the bill for an amendment to the criminal code, the emperor dismissed them both in October 1894. In 1899 Eulenburg took his seat in the Herrenhaus, or Prussian House of Lords.

Eulenspiegel, oi'lĕn-spē-gĕl, a typical character associated in Germany with all sorts of frolics and fooling. The type originated in Till or Tyll Eulenspiegel, a German clown who lived probably in the first half of the 14th century, and became celebrated for the wild pranks and escapades that he practised in all parts of Germany, and in some of the neighboring countries. According to popular account he was born at the village of Kneitlingen, near Brunswick, and died at Mölln, near Lübeck. The tricks and frolics currently attributed to Eulenspiegel first appear in a Low Saxon account written in 1483; the earliest edition, in High German, was published at Strasburg in 1519 by Thomas Murner. This work became very popular, and was translated into nearly every European language. In English it first appeared as a miracle-play, with the title 'A Merry Feast of a Man that was called Howleglas' (Eulenspiegel meaning literally "owl-glass"). An edition of Murner's original collection was published by J. M. Lappenberg at Leipsic in 1854, and English translations and editions appeared in 1860 and 1890.

Euler, oi'lĕr, **Leonard,** Swiss mathematician: b. Basel 15 April 1707; d. St. Petersburg 7 Sept. 1783. In his 19th year he gained the *accessit* of the prize offered by the Paris Academy of Sciences for the best treatise on the masting of vessels. In 1733 he became professor of mathematics in the Academy of St. Petersburg, where he labored with astonishing industry. He composed more than half of the treatises in this branch of science contained in the 46 quarto volumes published by the St. Petersburg Academy 1727–83; and at his death left about 100 unpublished dissertations, subsequently printed by the society. In 1741 he accepted an invitation from Frederick the Great to become professor of mathematics in the Berlin Academy, but in 1766 returned to St. Petersburg. He first gave the example of those long processes in which the conditions of the problem are first expressed by algebraic symbols, and then pure calculation resolves all the difficulties. He applied the analytic method to mechanics, and enlarged the boundaries of this science. He greatly improved the integral and differential calculus, of which he afterward published a complete course, which surpassed everything then extant on this subject. An extensive optical treatise, 'Sur la Perfection des Verres object. des Lunettes,' in the Mémoires de Berlin (1747), was the result of his inquiries into the means of improving spectacles. The share which he contributed by this work toward the discovery of achromatic telescopes is sufficient to distinguish his name in this department also. He also employed himself in metaphysical and philosophical speculations. He attempted to prove the immateriality of the soul, and to defend revelation against freethinkers. In his well-known 'Lettres à une Princesse d'Allemagne, sur Divers Sujets de Physique et de Philosophie' (1768–72), he attacks the Leibnitzian system of monads and pre-established harmony. Among his numerous writings may be mentioned here his 'Theoria Motuum Planetarum et Cometarum'; 'Introductio in Analysin Infinitorum,' which has always been regarded as his greatest production; 'Institutiones Calculi Differentialis'; 'Institutiones Calculi Integralis'; 'Introduction to Algebra'; his 'Dioptrica'; 'Opuscula Analytica.'

Eumenides, ū-mĕn'ī-dēz. See FURIES.

Eumol'pus, a mythical personage of ancient times, celebrated as a poet, warrior, hierophant, and legislator, according to the common tradition a Thracian, the son of Poseidon and Chione, the daughter of Boreas. He is said to have been driven from Thrace, but to have afterward returned. The accounts of his subsequent career vary. According to one tradition he was the founder of the Eleusinian mysteries, in which he was instructed by Demeter. The sacerdotal family of the Eumolpides at Athens claimed to be descended from this Eumolpus.

Euno'mians, the extreme faction of the Arian sect in the 4th century, so called from the name of their leader, Eunomius, who was made bishop of Cyzicus in Mœria 360, but who was deposed the following year. For 30 years thereafter he was the foremost champion of Anomœanism, or the doctrine that Jesus Christ the son of God is of different nature (or substance) from the Father (ἀνόμοιος κατ'οὐσίαν καὶ κατά παντα : unlike in substance and everything): thus his doctrine was that of Unitarianism. The doctrine of the Roman Catholic Church, declared in the Council of Nicæa, was that of ὁμοουσιαὰ consubstantiality; that of the Semi-Arians was that the Son is of like or similar substance, ὁμοιούσιος and hence they are called homœusians, while the orthodox took the name of homousians (both words usually written homoiousians, homoousians). To give solemn expression to their distinctive tenet the Eunomians changed the baptismal formula, «I baptize thee in the name of the Father,» etc., to this: «I baptize thee in the name of God, the Creator, into the death of Christ.»

Euno'mius, Arian bishop: b. Dacora, Cappadocia; d. there 392. In the controversy which gave rise to Arianism, Eunomius was an ardent disciple of Arius. So extreme were his views that he and his followers were looked upon as members of a party within the Arian ranks, and were called Eunomians. He was made bishop of Cyzicus in 360, and remained at the head of this see for some years. He lived the life of an exile after this on account of his views, but finally returned to his birthplace.

Eunuch, the keeper of a harem, generally a castrated man. Eunuchism is of prehistoric origin and prevails among all nations and peoples. Eunuchs were common in biblical times.

Euonymus, ū-ŏn'ĭ-mŭs, a genus of the staff-tree family (*Celastraceæ*), comprising upward of 65 species of shrubs, natives of the north temperate zone. Six species are found in America. The best known are the strawberry bush (*E. americanus*), the burning-bush or wahoo (*E. atropurpureus*) and the spindle-tree (*E. europeus*). (See SPINDLE-TREE.) From the bark of the wahoo or burning-bush, an extract known in medicine as euonymin, is obtained. It is used as a cholagogue, tonic and diuretic, and for its stimulant action on the liver.

Euornithes, ū-ôr'nĭ-thēz, a grand division of birds, which, according to some authors, includes all living birds except the ostriches and their allies and the penguins; and according to others includes all birds, modern and extinct, except Archæopteryx. In this sense it is equivalent to the preferable term *Neornithes* (q.v.).

Eupata'ria, or **Eupatoria**, Russia, seaport, in the government of Taurida, on the Black Sea, 40 miles northwest of Simferopol. Having long been possessed by the Tartars of the Crimea (who gave it the name of Kosloff or Kesloff), it is more Asiatic than European in its aspect. The salt lake of Sakè is a bathing resort. It was here that the allied forces landed at the commencement of the Crimean war (14-18 Sept. 1854). It was unsuccessfully attacked by the Russians 17 Feb. 1855. Pop. 17,757.

Eupato'rium, a genus of composite plants including many (about 400) species, especially characteristic of America, where several are well known. Among the most prominent are boneset or thoroughwort (*E. perfoliatum*), a native of low grounds distinguished by the fact that its opposite leaves are joined around the stem; and the joe-pyr-weed, or gravel-root (*E. purpureum*), whose purplish rosy flowers become conspicuous in late summer in wet meadows borne on stems often 12 feet high. The hemp-agrimony is a well-known British medicinal herb. The flower-heads in this genus are corymbs, all the florets tubular. Several of these plants have enjoyed from time immemorial a reputation in folk-medicine as remedies for the breaking up of fevers. Popular tradition has it that eupatorium is good for broken bones, the common name boneset preserving this notion. It has no such action. By reason of a certain amount of volatile and fixed oil which eupatorium contains it makes a fair diaphoretic mixture, and in the form of «boneset tea» it is of service in causing profuse sweating. This may be of service in the treatment of congestions in different parts of the body. See DIAPHORETICS.

Eupat'rides (Gr. εὐπατρίδαι, *eupatridai*, well-born), the aristocracy, or land-owning class of ancient Athens, distinguished from the *geomiroi*, or peasants, and the *demiourgoi*, or artisans.

Eupen, oĭ'pĕn (Fr. *Néaux*), Germany, town in Rhenish Prussia, on the Wenze, near the frontiers of Holland, 10 miles south-southwest of Aix-la-Chapelle. Its manufactures are numerous and varied. Eupen owes its manufacturing prosperity to the French refugees, who settled here while the town formed part of the duchy of Limburg, under Austrian rule. After the Peace of Lunéville, when this duchy was ceded to France, Eupen belonged to the department of Ourthe until the Peace of Paris in 1814, when this town, with other portions of Limburg, was ceded to Prussia. Pop. 15,587.

Eu'phemism, a figure of speech by which one avoids the use of words directly expressing anything improper, disagreeable, or painful, by the employment of phrases that suggest in a more delicate manner or under a more cheerful aspect the idea to be conveyed. Thus the Greeks, in speaking of the Erinyes or Furies, came to call them the Eumenides, or well-disposed, gracious goddesses, and sometimes *semnai theai*, «the august goddesses.» Nearly all languages have some euphemism for death, or to express the fact that one has died, as when we speak of the «departed.» In the Bible we have the phrases «he was gathered to his fathers,» «he has fallen asleep,» etc.; the Romans, with the same intention, said «he has lived» (*vixit*); the Germans say «he is ascended» (*er ist hinaufgegangen*), or «he has been made immortal» (*er ist verewigt worden*).

Euphorbiaceæ, ū-fôr-bĭ-ā'sẹ-ē (the *Spurge* family), a natural order of plants, consisting of more than 4,000 species of herbs, shrubs and trees arranged in 220 genera, some of which are well known for their ornamental and economic uses. They are, with few exceptions, natives of warm climates, especially of tropical America, and nearly every species has an acrid juice, usually poisonous, but sometimes made bland when heated. Among the members of the family are many species of commercial importance. Thus the juice of some species and the roots of others are used in medicine, for in plants of this kind are found croton oil, castor oil, etc. A few of the Euphorbiaceæ yield fragrant balsamic products; a few, although their juice is poisonous, yield a wholesome starch in considerable abundance (see MANIOC); a few are cultivated and used as pot-herbs, particularly species of *Plukenetia* in the East Indies; a few yield wholesome and agreeable sub-acid fruits, as *Cicca disticha* and *C. racemosa* in the East Indies; the seeds of some are edible, as those of the candle-nut (q.v.), etc.; the oil of the seeds is also in some cases used for food, like other bland oils, but more frequently for burning, as castor-oil, candle-nut oil, the oil of *Elæococca verrucosa* in Japan and Mauritius, and the solid oil of *Stillingia sebifera,* which is used in China for making candles, and in medical preparations as a substitute for lard. From *Hevea* is derived the highest grade of rubber produced in South America. Others yield dyestuffs. The timber of some of the Euphorbiaceæ is valuable — for example, African teak. Of the 210 genera, 10 are represented in the American flora, the most important being Croton, Ricinus (castor-oil plants), and the Euphorbia or spurge proper. This genus numbers about 700 species, most abundant in the warm parts of the north temperate zone, more than 125 of them being found in America. They are all known as «spurge,» and are more or less poisonous. Some one species is found in every part of America, those not native having escaped from cultivation. Some of the species are imposing ornamental plants and are much used in landscape gardening, and in greenhouses, usually for their curious forms of growth, rather than for their beauty.

Plants of this family, although of widely differing forms of growth and foliage, are characterized by unisexual, monœcious or diœcious flowers often brilliantly colored and often inconspicuous, in the latter case sometimes subtended by brilliantly colored bracts; the usually three-lobed fruits split elastically when ripe and throw the seeds to greater or less distances.

Euphor'bium. See GUMS.

Euphor'bus, in Greek mythology, the son of Panthous, slain by Menelaus in the Trojan war.

Euphrasia, a genus of plants of the figwort family (*Scrophulariaceæ*). It comprises about 110 species, natives of temperate and cold regions of both hemispheres, four of them occurring in North America. They are annual or perennial low-branched herbs, with small, blue, yellow or white flowers, generally known by the name eyebright. The principal American species are: *E. latifolia,* glandular eyebright; *E. americana,* hairy eyebright, the most widely distributed, and *E. oakesii,* oakes eyebright, found only in the White Mountains. The common English eyebright, *E. officinalis* is not known in America. This is a very pretty little plant, the flowers white streaked with purple, and a yellow spot on the lip. It grows so abundantly in some places, as to give the ground an appearance of being covered with snow, during the time of its flowering, from May to September. The whole plant is slightly aromatic. It has been used with success in catarrhal inflammations of the eye, in cough, hoarseness, earache, or headache which follow after catarrhs.

Euphrates, ū-frā'tēz, a celebrated river in Asiatic Turkey, having its sources in Central Armenia, at no great distance from the shores of the Euxine, and its mouth in the Persian Gulf; length, including windings, 1,716 miles. It is formed by the junction of two large streams, called the Kara-Su and the Mourad-Chai. These two head streams unite near Kaban Maden, about lat. 38° 58' N.; lon. 38° 30' E.; from which point the river holds in the main a southeasterly course, until it falls into the Persian Gulf. At Korna, about 100 miles from its mouth, it is joined by the Tigris, and the united streams take the name of the Shatt-el-Arab. In point of current the Euphrates is for the most part a sluggish stream, except in the height of the flooded season. The Shatt-el-Arab has a depth of from 3 to 5 fathoms, and presents banks covered with villages and cultivation. The most important town on the Shatt-el-Arab is Bassora or Basra. The melting of the snow in the mountains along the upper part of the river's course causes the Euphrates to rise. This takes place about the beginning of March, and it increases gradually up to the end of May. The river continues high for 30 or 40 days; but afterward there is a daily decrease. From the middle of September to the middle of October the river is at the lowest. The Euphrates is navigable for a long distance from the sea, but there are numerous rapids. Steamers navigate the Shatt-el-Arab. Between the Euphrates and the Tigris lies the celebrated region Mesopotamia.

Euphrates Valley Railway, a projected road from the Mediterranean coast of Asiatic Turkey to the Euphrates valley and Persian Gulf. Projects for shortening the journey to India by the construction of a railway in the Euphrates valley have been repeatedly discussed, and some such expeditious method of reinforcing the British troops in India has been regarded as highly desirable. The schemes spoken of have been various, but the original project was to connect the Bosphorus with the Persian Gulf. In 1901 an agreement was made between the Turkish government and the German company controlling the Anatolian Railway from the Bosphorus to Konia, whereby this railway is to be continued to Bagdad and Bassorah. There is already a line from Smyrna joining the line to Konia, and this would furnish a shorter through route.

Euphrosyne, ū-frŏs'ĭ-nē (Lat., from Gr. Εὐφροσύνη, the personification of joy, from εὔφρων, *euphron,* joyous), in Greek mythology, one of the three Graces (q.v.).

Euphues (ū'fū-ēz), **or the Anatomy of Wit,** and **Euphues and His England,** a book and its sequel, by John Lyly, published respectively in 1578 and 1580, when the author was a young courtier. They constitute the first and second part of a work which can only loosely be called fiction in the modern sense. Perhaps the word «romance» best expresses its nature. For a dozen years the work was fashionable in the polite circles of England; and the word "euphuism" survives in the language to designate the stilted, far-fetched, ornate style of writing introduced and made popular by Lyly. Although Lyly's style had in it too much of the affected to give it long life, he undoubtedly did something toward making the 16th century speech refined, musical, and choice. It is this rather than any attraction of story that makes the 'Euphues' interesting to the modern student of literature.

Eu'phuism, an affected style of speech which distinguished the conversation and writings of many of the wits of the court of Queen Elizabeth. The name and the style were derived from 'Euphues, or the Anatomy of Wit' (about 1579), and the 'Euphues and His England' (about 1581), of John Lyly. These books, which became the model of the wits and gallants of the time, and an acquaintance with which was regarded as a test of courtly breeding were characterized by smoothness and verbal elegance, but chiefly by fantastic similes and illustrations. Sir Walter Scott draws the portrait of a euphuist in the character of Sir Piercie Shafton, in 'The Monastery.'

Eupion, ū'pĭ-ŏn, or **Eupione,** Reichenbach's name for a fragrant colorless liquid produced in the destructive distillation of various animal and vegetable substances. It is highly volatile and inflammable; it is insoluble in water, but mixes with oils, and acts as a solvent for fats and resins. It is not readily acted on by ordinary chemical reagents.

Eura'sians (syncopated from Europe-Asians), a name given to the "half-castes" of India, the offspring of European fathers and Hindu mothers. They are particularly common in the three presidential capitals — Calcutta, Madras, and Bombay. They usually receive a European education, and speak English with grammatical correctness, although with an accent not altogether agreeable to English ears. The girls, in spite of their dark tint, are generally very pretty, and often become the wives of young officers or civil officials. The sons usually receive appointments in the civil service, or become clerks in merchants' offices. They are also often spoken of as East Indians. The word Eurasian is often extended to include all persons of mixed European and Asiatic descent.

Eure, ėr, France, a department in the northwest forming part of Normandy; area 2,300 square miles. The chief river which flows through it is the Seine. The mining and manufacturing industries are extensive. Pop. about 332,000.

Eure, a river of France, which has given its name to two departments — that of the Eure, and that of the Eure-et-Loir. The river rises in the department of the Orne, and flows into the Seine, near Pont-de-l'Arche, after a course of 124 miles, being navigable for about half the distance.

Eure-et-Loir, ėr-ā-lwär, France, a department in the northwest, forming part of the old provinces of Orléannais and Ile-de-France; area, 2,267 square miles. The department is essentially agricultural, and has few manufactures. The capital is Chartres. Pop. about 274,000.

Eureka, ū-rē'ka, a Greek word meaning "I have found it"; used as an expression of triumph at a discovery. See ARCHIMEDES.

Eureka, Cal., city, county-seat of Humboldt County; on Humboldt Bay, the Eel River, and the San Francisco & N. W., the California N., the Eureka & K. R. R.R.'s; 225 miles northwest of San Francisco. It has a fine harbor, which has been improved by the United States government on the jetty plan. The city is situated in the famous redwood region, and has large lumber interests. Sequoia Park, a tract of 40 acres of redwood forest, is near the city. The city has gas and electric lights, high schools, daily and weekly newspapers, and five banks. Pop. (1910) 11,845.

Eureka, Ill., city, county-seat of Woodford County; on the Atchison, T. & S. F. and the Toledo, P. & W. R.R.'s; 20 miles east of Peoria. Eureka College, under the auspices of the Christian Church, was established in 1855. The city is a trade centre for the surrounding agricultural college. Pop. (1910) 1,525.

Eureka, Kan., city, county-seat of Greenwood County; on Fall River; and on the Atchison, T. & S. F. and the Missouri P. R.R.'s; about 58 miles northeast of Wichita. It is the seat of the Southern Kansas Academy, under the auspices of the Congressional Church. The city is a trade centre for the surrounding rich agricultural region. Pop. (1910) 2,333.

Eureka, Nev., town, county-seat of Eureka County; on the Southern P. R.R. Some of the richest mines of the State are near, lead, gold, and silver; and many other valuable minerals are found in Eureka and adjoining counties. The town has numerous and important smelting and refining works. Because of severe fires, destroying a large portion of the place, the population decreased from 5,000 in 1880 to 661 in 1910.

Eureka College, a coeducational institution in Eureka, Ill.; founded in 1855 under the auspices of the Christian Church; reported at the close of 1910: Professors and instructors, 23; students, 200; and volumes in the library, 10,000.

Eureka Springs, Ark., city and county-seat of Carroll County; situated in the Ozark Mountains in the northwestern part of the State, and on the Eureka Springs R.R., 18 miles southeast of Seligman, Mo. The city is chiefly noted for its medicinal springs and its healthful climate, and very little manufacturing is carried on. Onyx of a fine grade is found in the vicinity. The city has a high school and three graded public schools; there are two banks, with a combined capital of $50,000, and 10 church edifices. The city is lighted by gas, owns and operates its waterworks and has an electric railway system. The affairs of the community are administered by a mayor and council of six members elected every two years. It was first settled in 1879 and became a city in 1880. The population are mainly Americans. Pop. (1910) 3,228.

E. M. BARE,
Secretary Commercial Club.

Euripides, ū-rĭp'ĭ-dēz, Greek tragic poet: b. Salamis, probably 23 Sept. 480 B.C., d. 406 B.C. The date given for his birth by the Arundel marbles is 485 B.C.; and Müller upholds the date

481 B.C., on the ground that Eratosthenes states him to have been 75 at his death. The usual account, however, places it on the day of the battle of Salamis. Euripides is said to have begun to write tragedies at the age of 18, but no play was exhibited by him until 455 B.C., the year in which he exhibited the 'Peliades.' He was not successful in gaining the first prize till the year 441 B.C., and he continued to exhibit till 408 B.C., when he exhibited the 'Orestes.' Most of the short remainder of his life was passed at the court of Archelaus, king of Macedonia, where he was held in the highest honor. The honor paid to Euripides by Archelaus is not the only proof of the estimation in which he was held by foreigners. Plutarch records in his 'Nicias' that on the occasion of the destruction of the Athenian army in Sicily, under Demosthenes and Nicias, by the Syracusans (413 B.C.), many of those who survived, and were made prisoners, obtained their liberty by reciting to their masters some of the verses of Euripides, and he adds that numbers of them on their return home visited the poet to express their thanks to him. The Athenians themselves did not neglect to do honor to their great poet after his death, for Pausanias makes mention of a statue to him that stood in the theatre of Athens.

Euripides made it a chief aim to awaken the tender emotions. «He knew,» says one critic, «the nature of the passions, and had the art of inventing situations in which they could have their full play. Most of his characters were once in the enjoyment of distinguished prosperity, and the retrospect, in their present situation, checks the violence of the passions, and lowers them to the tone of lamentation. For this reason, in his tragedies the passions are breathed forth in soft complaints, rather than raised to a lofty height; for the same reason he is so rich in moral sentences and philosophical declamations, as his personages have always coolness enough to reflect on their situation. Euripides knew well what was suited to produce an effect at the moment. The times of boldness, when Æschylus wrote, were past, and the power of the state was beginning gradually to sink. The pathetic manner of Euripides then became popular.» Various faults may be found with his loose plan, his often unintelligible changes of character, his superfluous choruses, and sometimes, too, his subject; but he stands pre-eminent in true, natural expression of the passions, in interesting situations, original groupings of character and varied knowledge of human nature. He is a master, too, in the art of managing the dialogue, in adapting the speeches and answers to the character, the sex, and station, the known or private views, the present disposition of the speaker, and the necessity of the moment, in short, to all that gives distinctness and individuality to a person. There is, too, a certain tenderness and softness diffused over his writings, which cannot fail to please the mind. He has been often called the woman-hater; but this seems to be rather a random charge, and was made probably on account of his many severe strictures on the follies of the female sex.

The number of tragedies composed by Euripides is stated by one authority to be 75, of which only 5 are said to have gained him the prize; according to another authority the total number of his tragedies reached 92, 15 of which gained him the prize. His extant plays amount to 18, or 19 if the 'Rhesus' be included in the number, as it is by some scholars, although others reject it as spurious. The following are the extant plays of Euripides: 'Alcestis'; 'Medea'; 'Hippolytus Coronifer'; 'Hecuba'; 'Heracleidæ'; 'Supplices'; 'Ion'; 'Hercules Furens'; 'Andromache'; 'Troades'; 'Electra'; 'Helena'; 'Iphigenia in Tauride'; 'Orestes'; Phœnissæ'; 'Bacchæ'; 'Iphigenia in Aulide'; and 'Cyclops.' The works of Euripides have been translated into verse by Way (1894-8); and into prose by E. P. Coleridge (1885). See Mahaffy, 'Introduction to the Study of Euripides' (1879); Lawton, 'Three Dramas of Euripides' (1889); Decharme, 'Euripide et l'esprit de son théâtre' (1893); Verrall, 'Euripides the Rationalist' (1895); Haigh, 'Tragic Drama of the Greeks' (1876); England, 'Euripides and the Attic Oration' (1898); Nestle, 'Euripides, der Dichter der griechischen Aufklärung' (1901).

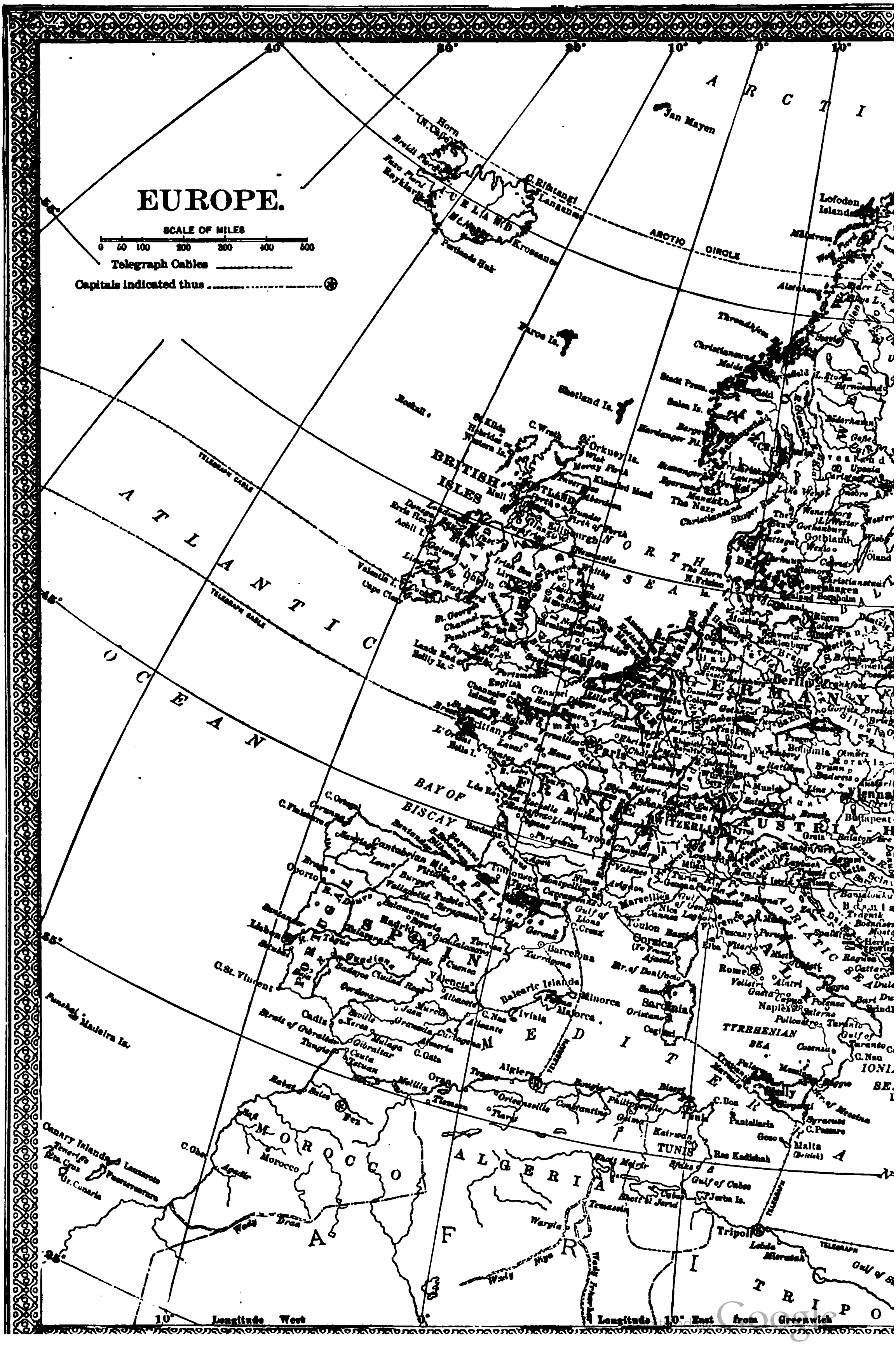
Euripus, ū-rī'pŭs, in ancient geography, the strait between the island of Eubœa and the mainland, Bœotia in Greece. At Chalcis, the width at the narrowest part was 120 feet.

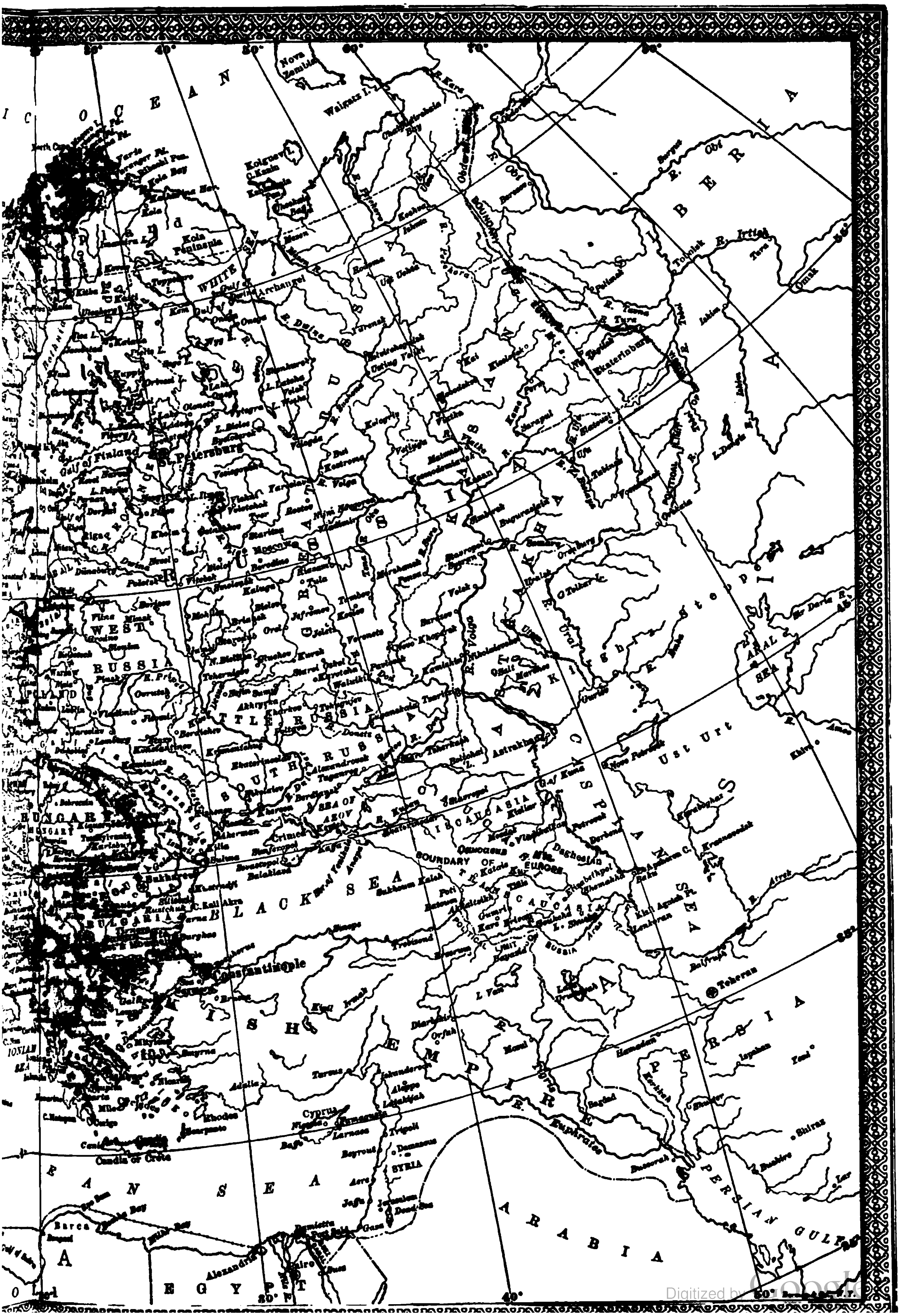
Euroclydon, ū-rŏk'lĭ-dŏn, a tempestuous wind that frequently blows in the Levant, and which was the occasion of the disastrous shipwreck of the vessel in which St. Paul sailed, as narrated in Acts xxvii. 14-44. In the form in which the word is found in the revised version it must be taken as made up of the two Greek words, *euros,* the east or rather southeast wind, and *klydŏn,* a wave. But the word used for it in the Vulgate is *Euro-aquilo,* a Latin compound signifying a northeast wind; and some of the best MSS. have the reading *Eurakylŏn* instead of *Euroclydon,* which is accepted by some scholars as the preferable reading. Whatever may have been the true form of the word, it was applied to a northeast or north-northeast, and not an east or southeast wind, as the course taken by the vessel referred to indicates. Exactly such a wind is described by sailors of the present day as prevalent at certain seasons (especially in early spring) in the Mediterranean. The name by which the wind is now known is *Gregalia.*

Europa, ū-rō'pạ, in Greek mythology, the daughter of Agenor, king of the Phœnicians, and the sister of Cadmus. The fable relates that she was abducted by Jupiter, who assumed the form of a bull, and swam with his prize to the island of Crete. Here Europa bore to him Minos, Sarpedon, and Rhadamanthus.

Europe, the smallest of the great continents but the most important, distinguished above the others by the character of its population, the superior cultivation of the soil, and the flourishing condition of arts, sciences, industry and commerce.

Topography.— Europe forms a huge peninsula projecting from Asia, and is bounded on the north by the Arctic Ocean; on the west by the Atlantic Ocean; on the south by the Mediterranean, the Black Sea, and the Caucasus range; on the east by the Caspian Sea, the Ural River, and the Ural Mountains. The most northerly point on the mainland is Cape Nordkyn, in Lapland, in lat 71° 6′ N.; the most southerly


EUROPE.
SCALE OF MILES
0 50 100 200 300 400 500
Telegraph Cables
Capitals indicated thus
40° 30° 20° 10° 0° 10°
55° 45° 35° 25°
A R C T I
Jan Mayen
Horn (N. Cape)
C. Rifstangi
Langanes
ICELAND
Reykiavik
Krossanes
Portlands Hak
ARCTIC CIRCLE
Lofoden Islands
Faroe Is.
Shetland Is.
Rockall
Throndhjem
Christiansund
Molde
Stadt Prom.
Bergen
Hardanger Fd.
Stavanger
The Naze
Christiansand
Skager Rack
St. Kilda
Hebrides or Western Is.
C. Wrath
Orkney Is.
Moray Firth
Kinnaird Head
Aberdeen
BRITISH ISLES
SCOTLAND
Mull
Dundee
Firth of Forth
Edinburgh
Glasgow
Londonderry
Erris Head
Achill I.
Galway
Limerick
Dublin
Irish Sea
Valentia I.
Cape Clear
Cork
Waterford
St. George's Channel
Pembroke
Liverpool
Whitby
Hull
Manchester
Birmingham
Cambridge
London
Bristol
Plymouth
Lands End
Scilly Is.
Portsmouth
English Channel
Channel Islands
Brest
Brittany
L'Orient
Belle I.
TELEGRAPH CABLE
A T L A N T I C
O C E A N
N O R T H S E A
The Horn
N. Frisian Is.
Gothenburg
Cattegat
Gothland
Öland
Christianstadt
Copenhagen
Bornholm
Rügen
Hamburg
Hanover
Berlin
Stettin
Danzig
G E R M A N Y
Frankfort
Dresden
Breslau
Prague
Bohemia
Moravia
Munich
Vienna
Budapest
AUSTRIA-H
Tyrol
Gratz
Brussels
Cologne
Paris
Havre
Versailles
Orleans
Le Mans
Laval
Nantes
FRANCE
Rochelle
Limoges
Bordeaux
Lyons
Toulouse
Montpellier
Nismes
Avignon
Marseilles
Toulon
Nice
SWITZERLAND
Geneva
Turin
Milan
Genoa
Parma
Bologna
Venice
Trieste
Florence
Leghorn
Rome
Naples
Salerno
Taranto
Bari
Foggia
Gulf of Lions
ADRIATIC SEA
Corsica
Ajaccio
Sardinia
Cagliari
TYRRHENIAN SEA
Palermo
Messina
Sicily
Syracuse
C. Passaro
Malta
IONI.
BAY OF BISCAY
C. Ortegal
C. Finisterre
Corunna
Santander
Bilbao
Cantabrian Mts.
Pyrenees
Leon
Burgos
Valladolid
Saragossa
Oporto
Salamanca
Madrid
Toledo
Lisbon
PORTUGAL
S P A I N
Badajoz
Valencia
Cordova
Murcia
Cartagena
Granada
Malaga
Cadiz
Gibraltar
Strait of Gibraltar
C. St. Vincent
Barcelona
Tarragona
Balearic Islands
Majorca
Minorca
Iviza
M E D I T E R R A N E A
Funchal
Madeira Is.
Tangier
Ceuta
Tetuan
Melilla
Oran
Algiers
Bougie
Bona
Constantine
Philippeville
Biserta
Tunis
C. Bon
Pantellaria
Kairwan
TUNIS
Sfakes
Gulf of Cabes
Jerba Is.
Tripoli
Lebda
Misratah
Gulf of Sidra
Rabat
Fez
Tlemcen
Orleansville
Tiaret
M O R O C C O
Morocco
Agadir
C. Ghir
Canary Islands
Lanzarote
Fuerteventura
Teneriffe
Sta. Cruz
Gr. Canaria
A L G E R I A
Shott Melrir
Shott el Jerid
Wargla
Wadi Draa
A F R I C A
T R I P O
Longitude West
Longitude 10° East from Greenwich



30°
40°
50°
60°
70°
80°
OCEAN
Nova Zembla
Waigatz I.
R. Kara
Kolguev I.
C. Kanin
Obi
Berezov
SIBERIA
Surgut
R. Irtish
Tobolsk
Tara
Omsk
Kola
Kola Peninsula
Kola Bay
North Cape
Vardo
WHITE SEA
Gulf of Onega
Archangel
Mezen
Onega
R. Dwina
R. Petchora
Ust Ussolsk
Ust Sysolsk
Lake Ladoga
L. Onega
Olonetz
Petrozavodsk
Vologda
Veliki Ustiug
Kostroma
Jaroslav
Gulf of Finland
St. Petersburg
Novgorod
Tver
Riga
Gulf of Riga
Dorpat
Pskov
Moscow
Borodino
Vitebsk
Smolensk
Kaluga
Tula
Riazan
Vladimir
Nijni Novgorod
Kazan
R. Volga
Viatka
Perm
Kama R.
Ekaterinburg
Ural Mts.
Ufa
Sarapul
Zlatoust
Simbirsk
Samara
Orenburg
Buguruslan
Troitsk
Ishim
L. Denga
Tobol R.
RUSSIA
Vilna
Minsk
WEST RUSSIA
Grodno
Warsaw
POLAND
Mohilev
Orel
Kursk
Tambov
Voronezh
Saratov
Volsk
Penza
Kharkov
Poltava
Kiev
LITTLE RUSSIA
Tchernigov
Jitomir
Berditchev
Lemberg
Kamenetz
Kishenev
SOUTH RUSSIA
Ekaterinoslav
Taganrog
Kherson
Nicolaiev
Odessa
Perekop
Crimea
Kaffa
Sevastopol
Balaklava
SEA OF AZOV
R. Don
Tcherkask
Novo Tcherkask
R. Kuban
Stavropol
Astrakhan
Tsaritsin
Kamishin
Nikolaevsk
Uralsk
Ural R.
Orsk
Ilek
KIRGHIZ STEPPE
Ust Urt
ARAL SEA
Syr Daria R.
Khiva
Amoo
Gulf Karasu
Novo Petrovsk
Kizliar
Mozdok
Vladikavkaz
Petrovsk
Derbend
Daghestan
CAUCASIA
Caucasus
BOUNDARY OF EUROPE
Tiflis
Kutais
Poti
Sukhum Kaleh
Batoum
Akhaltsikh
Gumri
Kars
Erivan
Shemakha
Elisabethpol
Baku
Apsheron C.
Lenkoran
Kizil Agatch B.
Krasnovodsk
Karabogaz
R. Atrek
CASPIAN SEA
BLACK SEA
POLITICAL LIMIT OF RUSSIA
Trebizond
Erzerum
Bayazid
L. Van
L. Urumiah
Balfrush
Teheran
PERSIA
Hamadan
Ispahan
Yezd
Kermanshah
Shuster
Shiraz
Bushire
Lar
PERSIAN GULF
Bagdad
Bussorah
Euphrates
Tigris
Mosul
Orfah
Diarbekir
TURKISH EMPIRE
Sinope
Brussa
Constantinople
Smyrna
Adalia
Tarsus
Iskanderoon
Aleppo
Ladakieh
Tripoli
Beyrout
Damascus
SYRIA
Acre
Jaffa
Jerusalem
Dead Sea
Gaza
Cyprus
Larnaca
Famagusta
Nicosia
Baffa
Rhodes
Candia
Candia or Crete
Scarpanto
IONIAN SEA
BULGARIA
Varna
Rustchuk
Silistria
Bucharest
Galatz
Ismail
Kilia
Sulina
Akkerman
Bender
Kustendji
C. Kali Akra
Bourgas
HUNGARY
Transylvania
Karlsburg
Bessarabia
Dniester
Pruth
Barca
Bengazi
Gulf of Sidra
Bay
Alexandria
Damietta
Port Said
Cairo
Suez
EGYPT
ARABIA
MEDITERRANEAN SEA
AFRICA
20°
30°
40°
50°

points are Punta da Tarifa, lat. 36° N., in the Strait of Gibraltar, and Cape Matapan, lat. 36° 17', which terminates Greece. The most westerly point is Cape Roca in Portugal, in lon. 9° 28' W., while Ekaterinburg is in lon. 60° 36' E. From Cape Matapan to North Cape is a direct distance of 2,400 miles, from Cape St. Vincent to Ekaterinburg, northeast by east, 3,400 miles; area of the continent, about 3,800,000 square miles. Great Britain and Ireland, Iceland, Nova Zembla, Corsica, Sardinia, Sicily, Malta, Crete, the Ionian and the Balearic Islands are the chief islands of Europe. The shores are very much indented, giving Europe an immense length of coast line (estimated at nearly 50,000 miles). The chief seas or arms of the sea are: the White Sea on the north; the North Sea, or German Ocean, on the west, from which branches off the great gulf or inland sea known as the Baltic; the English Channel, between England and France; the Mediterranean, communicating with the Atlantic by the Strait of Gibraltar (at one point only 19 miles wide); the Adriatic and Aegean seas, branching off from the Mediterranean, and the Black Sea, connected with the Aegean Sea through the Hellespont, Sea of Marmora, and Bosporus.

The mountains form several distinct groups or systems of very different geological dates, the loftiest mountain masses being in the south central region. The Scandinavian mountains in the northwest, to which the great northern peninsula owes its form, extend above 900 miles from the Polar Sea to the southern point of Norway. The highest summits are about 8,000 feet. The Alps, the highest mountains in Europe (unless Mount Elbruz in the Caucasus is claimed as European), extend from the Mediterranean first in a northerly and then in an easterly direction, and attain their greatest elevation in Mont Blanc (15,781 feet), Monte Rosa, and other summits. Branching off from the Alps, though not geologically connected with them, are the Apennines, which run southeast, through Italy, constituting the central ridge of the peninsula. The highest summit is Monte Corno (9,541 feet). Mount Vesuvius, the celebrated volcano in the south of the peninsula, is quite distinct from the Apennines. By southeastern extensions the Alps are connected with the Balkan and the Despoto-Dagh of the southeastern peninsula of Europe. Among the mountains of southwestern Europe are several massive chains, the loftiest summits being in the Pyrenees, and in the Sierra Nevada in the south of the Iberian Peninsula. The highest point in the former, La Maladetta or Mont Maudit, has an elevation of 11,165 feet; Mulahacen, in the latter, is 11,703 feet, and capped by perpetual snow. West and northwest of the Alps are the Cévennes, Jura, and Vosges; north and northeast, the Harz, the Thüringerwald Mountains, the Fichtelgebirge, the Erzgebirge and Böhmerwaldgebirge. Farther to the east the Carpathian chain encloses the great plain of Hungary, attaining an elevation of 8,000 or 8,500 feet. The Ural Mountains between Europe and Asia reach the height of 5,540 feet. Besides Vesuvius two other volcanoes are Etna in Sicily, and Hecla in Iceland. A great part of northern and eastern Europe is level. The "great plain" of north Europe occupies part of France, western and northern Belgium, Holland, the northern provinces of Germany, and the greater part of Russia. A large portion of this plain, extending through Holland and north Germany, is a low sandy level not infrequently protected from inroads of the sea only by means of strong dykes. The other great plains of Europe are the plain of Lombardy (the most fertile district in Europe) and the plain of Hungary. Part of southern and southeastern Russia consists of steppes.

Rivers and Lakes.— The main European watershed runs in a winding direction from southwest to northeast, at its northeastern extremity being of very slight elevation. From the Alps descend some of the largest of the European rivers, the Rhine, the Rhône, and the Po, while the Danube, a still greater stream, rises in the Black Forest north of the Alps. The Volga, which enters the Caspian Sea, an inland sheet without outlet, is the longest of European rivers, having a direct length of nearly 1,700 miles, including windings of 2,400 miles. Into the Mediterranean flow the Ebro, the Rhône, and the Po; into the Black Sea, the Danube, Dnieper, Dniester, and Don (through the Sea of Azov); into the Atlantic, the Guadalquivir, the Guadiana, the Tagus, and Loire; into the English Channel, the Seine; into the North Sea, the Rhine, Elbe; into the Baltic, the Oder, the Vistula, and the Duna; into the Arctic Ocean, the Dwina. The lakes of Europe may be divided into two groups, the southern and the northern. The former run along both sides of the Alps, and among them, on the north side, are the lakes of Geneva, Neuchâtel, Thun, Lucerne, Zürich, and Constance; on the south side, Lago Maggiore, and the lakes of Como, Lugano, Iseo, and Garda. The northern lakes extend across Sweden from west to east, and on the east side of the Baltic a number of lakes, stretching in the same direction across Finland on the borders of Russia, mark the continuation of the line of depression. It is in Russia that the largest European lakes are found — Lakes Ladoga and Onega.

Geology.— The geological features of Europe are exceedingly varied. The older formations prevail in the northern part as compared with the southern half and the middle region. North of the latitude of Edinburgh and Moscow there is very little of the surface of more recent origin than the strata of the upper Jura belonging to the Mesozoic Period, and there are vast tracts occupied either by eruptive rocks or one or other of the older sedimentary formations. Denmark and the portions of Germany adjoining belong to the Cretaceous Period, as does also a large part of Russia between the Volga and the basin of the Dnieper. Middle and eastern Germany with Poland and the valley of the Dnieper present on the surface Eocene formations of the Tertiary Period. The remainder of Europe is remarkable for the great diversity of its superficial structure, rocks and deposits belonging to all periods being found within it, and having for the most part no great superficial extent. Europe possesses abundant stores of those minerals which are of most importance to man, such as coal and iron, Great Britain being particularly favored in this respect. Coal and iron are also obtained in France, Belgium, and Germany. Gold is found to an unimportant extent, and silver is widely spread in small quantities. The richest silver ores are in Norway, Spain, the Erzgebirge, and the Harz Mountains. Spain is also rich in quicksilver. Copper ores are abundant in the Ural Mountains, Thuringia, Cornwall, and Spain. Tin ores are found in Cornwall, the Erzgebirge, and Brittany.

Climate.— Several circumstances concur to give Europe a climate peculiarly genial, such as its position almost wholly within the temperate zone, and the great extent of its maritime boundaries. Much benefit is also derived from the fact that its shores are exposed to the warm marine currents and warm winds from the southwest, which prevent the formation of ice on most of its northern shores. The eastern portion has a less favorable climate than the western. The extremes of temperature are greater, the summer being hotter and the winter colder, while the lines of equal mean temperature decline south as we go east. The same advantages of mild and genial temperature which western has over eastern Europe, the continent collectively has over the rest of the Old World. The diminution of mean temperature, as well as the intensity of the opposite seasons, increases as we go east. Peking, in lat. 40° N., has as severe a winter as St. Petersburg in lat. 60°.

Botany.— With respect to the vegetable kingdom Europe may be divided into four zones. The first, or most northern, is that of fir and birch. The birch reaches almost to North Cape; the fir ceases a degree farther south. The cultivation of grain extends farther north than might be supposed. Barley ripens even under the 70th parallel of north latitude; wheat ceases at 64° in Norway to lat. 62° in Sweden. Within this zone, the southern limit of which extends from lat. 64° in Norway to lat. 62° Russia, agriculture has little importance, its inhabitants being chiefly occupied with the care of reindeer or cattle, and in fishing. The next zone, which may be called that of the oak and beech, and cereal produce, extends from the limit above mentioned to the 48th parallel. The Alps, though beyond the limit, by reason of their elevation belong to this zone, in the moister parts of which cattle husbandry has been brought to perfection. Next we find the zone of the chestnut and vine, occupying the space between the 48th parallel and the mountain chains of southern Europe. Here the oak still flourishes, but the pine species become rarer. Rye, which characterizes the preceding zone on the continent, gives way to wheat, and in the southern portion of it to maize also. The fourth zone, comprehending the southern peninsula, is that of the olive and evergreen woods. The orange, lemon, and olive flourish in the southern portion of it, and rice is cultivated in a few spots in Italy and Spain.

Zoology.— As regards animals the reindeer and polar bears are peculiar to the north. In the forests of Poland and Lithuania the urus, a species of wild ox, is still occasionally met with. Bears and wolves still inhabit the forests and mountains; but, in general, cultivation and population have expelled wild animals. The domesticated animals are nearly the same throughout. The ass and mule lose their size and beauty north of the Pyrenees and Alps. The Mediterranean Sea has many species of fish, but no great fishery; the northern seas, on the other hand, are annually filled with countless shoals of a few species, chiefly the herring, mackerel, cod, and salmon.

Inhabitants.— Europe is occupied by several different peoples or races, in many parts now greatly intermingled. The Celts once possessed the west of Europe from the Alps to the British Islands. But the Celtic nationalities were broken by the wave of Roman conquest, and the succeeding invasions of the Germanic tribes completed their political ruin. At the present day the Celtic language is spoken only in the Scotch highlands (Gaelic), in some parts of Ireland (Irish), in Wales (Cymric), and in Brittany (Armorican). Next to the Celtic comes the Teutonic race, comprehending the Germanic and Scandinavian branches. The former includes the Germans, the Dutch, and the English. The Scandinavians are divided into Danes, Swedes, and Norwegians. To the east, in general, of the Teutonic race, though sometimes mixed with it, come the Slavonians, that is, the Russians, the Poles, the Czechs or Bohemians, the Servians, Croatians, etc. In the south and southeast of Europe are the Greek and Latin peoples, the latter comprising the Italians, French, Spanish and Portuguese. All these peoples are regarded as belonging to the Indo-European or Aryan stock. To the Mongolian stock belong the Turks, Finns, Lapps, and Magyars or Hungarians, all immigrants into Europe in comparatively recent times. The Basques at the western extremity of the Pyrenees are a people whose affinities have not yet been determined. The total population of Europe is about 394,000,000; nine tenths speak the languages of the Indo-European family, the Teutonic group numbering about 108,000,000, the Slavonic and Latin over 95,000,000 each. The prevailing religion is the Christian, embracing the Roman Catholic Church, the various sects of Protestants (Lutheran, Calvinistic, Anglican, Baptists, Methodists, etc.), and the Greek Church. A part of the inhabitants profess the Jewish, a part the Mohammedan religion.

Political Divisions.— The states of Europe, with their respective areas and populations, are as shown below. In addition to those given in the table, there are also the insignificant states of Andorra, Monaco, and San Marino, which still maintain a kind of precarious independence.

Area and Population.— The following table shows the countries with their government, area, and population according to "The Statesman's Year Book" (1910).

Countries	Government	Area in Eng. Sq. M.	Population
Andorra	Republic	175	6,000
Austria-Hungary	Empire	241,333	(1900) 45,405,267
Belgium	Kingdom	11,373	(1908) 7,386,444
Bulgaria	Principality	38,080	(1908) 4,158,409
Denmark	Kingdom	15,592	(1906) 2,605,268
France	Republic	207,054	(1906) 39,252,245
Germany	Empire	208,780	(1905) 60,641,278
Great Britain and Ireland	Kingdom	121,391	(1901) 41,976.827

COUNTRIES	Government	Area in Eng. Sq. M.	Population
Greece	Kingdom	25,014	(1907) 2,631,952
Italy	Kingdom	110,659	(1909) 34,270,000
Lichtenstein	Principality	65	(1906) 9,650
Luxemburg	Grand Duchy	998	(1900) 236,543
Monaco	Principality	8	(1910) 19,121
Montenegro	Principality	3,630	250,000
Netherlands	Kingdom	12,648	(1908) 5,825,198
Norway	Kingdom	124,130	(1900) 2,240,032
Portugal	Republic	35,490	(1907) 5,668,954
Rumania	Kingdom	50,720	(1908) 6,771,722
Russia (European)	Empire	1,862,524	(1908) 113,841,000
San Marino	Republic	38	(1909) 10,310
Servia	Kingdom	18,650	(1905) 2,688,025
Spain	Kingdom	194,783	(1900) 18,618,086
Sweden	Kingdom	172,876	(1908) 5,429,600
Switzerland	Republic	15,976	(1908) 3,559,349
Turkey (European)	Empire	65,350	(1909) 6,130,200
Bosnia, Herzegovina, and Novi Bazar, occupied by Austria-Hungary	Empire	19,702	1,568,092

History.— Europe was probably first peopled from Asia, but at what date we know not. The first authentic history begins in Greece at about 776 B.C. Greek civilization was at its most flourishing period about 430 B.C. After Greece came Rome, which, by the early part of the Christian era, had conquered Spain, Greece, Gaul, Helvetia, Germany between the Danube and the Alps, Illyria, Dacia, etc. Improved laws and superior arts of life spread with the Roman empire throughout Europe, and the unity of government was also extremely favorable to the extension of Christianity.

With the decline of the Roman empire a great change in the political constitution of Europe was produced by the universal migration of the northern nations. The Ostrogoths and Lombards settled in Italy, the Franks in France, the Visigoths in Spain, and the Anglo-Saxons in South Britain, reducing the inhabitants to subjection or becoming incorporated with them. Under Charlemagne (771–814) a great Germanic empire was established, so extensive that the kingdoms of France, Germany, Italy, Burgundy, Lorraine, and Navarre were afterward formed out of it. About this time the northern and eastern nations of Europe began to exert an influence in the affairs of Europe. The Slavs, or Slavonians, founded kingdoms in Bohemia, Poland, Russia, and the north of Germany; the Magyars appeared in Hungary, and the Normans agitated all Europe, founding kingdoms and principalities in England, France, Sicily, and the East. The Crusades and the growth of the Ottoman power are among the principal events which influenced Europe from the 12th to the 15th century.

The conquest of Constantinople by the Turks (1453), by driving the learned Greeks from this city, gave a new impulse to letters in western Europe, which was carried onward by the invention of printing and the development of national life in the European states. The discovery of America was followed by the temporary preponderance of Spain in Europe, and next of France. Subsequently Prussia and Russia gradually increased in territory and strength. The French Revolution (1789) and the Napoleonic wars had a profound effect on Europe, the dissolution of the old German empire being one of the results. Since then the most important events in European history have been the separation of Belgium from Holland, and the establishment of the independence of Greece, both in 1830; the disappearance of Poland as a separate state; the Crimean war of 1854–56 in which Great Britain, France, and Sardinia maintained the integrity of Turkey against Russia; the unification of Italy under Victor Emmanuel; the Franco-German war, resulting in the consolidation of Germany into an empire under the leadership of Prussia, and the establishment of the Third Republic in France; the attempt of Russia in 1877 to again sweep Turkey from her rank as a European nation; the partial dismemberment of the Turkish empire, including the loss of Crete and the unsuccessful war of the Greeks against the Turks in 1897.

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European Saratoga, The, Baden-Baden, famous for its medicinal waters and as a resort of fashion. Similarly, Saratoga has been named the "American Baden-Baden."

Eurotas, ū-rō'tas, or **Iri,** a river of southern Greece (Peloponnesus), at one time called the Iris and Niris in the upper, and the Basilipotamo (King's River) in the lower part of its course, flows in a southerly direction through the valley between the ranges of Taygetus and Parnon, and enters the Gulf of Kolokytha.

Euro'tia, a genus of the goosefoot family (*Chenopodiaceæ*), which comprises two species, one of which, *E. lanata,* is found in America, and is generally known as American Eurotia or white sage. It is a many-branched herb, from one to three feet high, the flowers densely covered with long silky hairs. It is found from June to September in dry soils in the northwest Territories, from western Nebraska to New Mexico, Nevada and California. It is also called winter fat, being gathered and used as a winter forage; it has been successfully employed as a remedy for intermittent fevers.

Euryale, ū-rī'ạ-lē, a genus of the water lily family (*Nymphæaceæ*). It has but one species, *Euryale ferox,* a native of China and southeastern Asia. The plant is covered with spines; the flowers are small, red, or purplish, and the leaves very large, sometimes four feet in diameter. The seeds are rich in starch, and in the native countries of the plant, are an article of commerce, being roasted and eaten, or used in soups. The root is also eaten. The plant is hardy and will grow out of doors in America and reproduce itself as far north as Baltimore. In some instances it has grown for a number of years even farther north, but an unusually severe winter will kill it, unless protected.

Eurydice, ū-rid'ĭ-sē, in Greek mythology, the wife of Orpheus, who died by the bite of a serpent. Her husband, inconsolable for her loss, descended to the lower world, and, by the charms of his lyre, moved the infernal deities to grant him permission to bring her back. This they granted, on condition that he would not look back upon her till he had reached the upper world. Forgetting his promise, he looked and lost her forever. This story has often formed a subject for poets — as for Virgil in the Georgics (book iv.), and for Pope in his ‹Ode on St. Cecilia's Day.› One of the first modern operas was the ‹Eurydice› (Euridice) of Coccini and Peri. It was first produced at Florence in 1600. The name Eurydice was borne by certain Macedonian princesses.

Euryl'ochus. See Circe.

Eurymone, ū-rĭm'ō-nē, an infernal deity, who gnawed the dead to the bones, and was always grinding her teeth. Also a daughter of Apollo.

Eurynome, ū-rĭn'ō-mē, in Greek mythology, the daughter of Oceanus and mother of the Graces.

Eurypterus, ū-rĭp'tē-rŭs, a remarkable fossil arthropod related to the horseshoe crab (*Limulus*), many genera and species of which occur in Palæozoic rocks of western Europe and eastern North America. They include the largest arthropods known, and form the family *Eurypteridæ* and order *Eurypterida* of the subclass *Merostomata* (q.v.). They resembled the modern horseshoe crabs in structure, but had elongated, often scorpion-like bodies, terminating in a hinged, spike-like or flattened tail or telson. The most remarkable feature, however, is the great size they attained, some exceeding six feet long, so that they were well named by Haeckel *Gigantosraca.* The surface was formed by a thin chitinous epidermal skeleton, ornamented by fine scale-like markings, and bearing upon the head-shield two large lateral faceted eyes and a pair of median ocelli. Beneath the cephalo-thorax are six pairs of legs, the foremost preoral, the basal joints of which serve as jaws. The last pair is greatly enlarged, somewhat flattened and terminated by an oval plate, which suggests that these limbs served as paddles in swimming, but they may have been otherwise useful. In *Pterygotus* and some allied genera the preoral limbs are modified into more or less antennæ-like organs terminating in toothed pincers (chelæ), no doubt for seizing prey, etc. The ventral segments are 13, of which the first 2 bear the genital organs, and the remainder leaf-like structures regarded as respiratory and equivalent to the «bookgills» of *Limulus.* These extraordinary crustaceans are found associated with graptolites, cephalopods, and trilobites in the Ordovician; with marine crustacea in the Silurian; with oceanic fishes in the Devonian, and with land and fresh-water plants and animals in the coal measures. Their structure shows that they must have been aquatic (marine) and good swimmers; but toward the end of their race they became gradually adapted to brackish and even fresh water. The latest review of the group is in Eastman's American edition of Zittell's ‹Text-book of Palæontology› (1900), which contains a full bibliography. See Merostomata.

Eurysthenes (ū-rĭs'thẹ-nēz) **and Procles,** prō'clēz, the twin sons of Aristodemus, and the progenitors of the two royal lines of Sparta.

Eurystheus, ū-rĭs'thūs, the son of Sthenelus, and king of Mycenæ, who, at Juno's instigation, ordered Hercules to perform «the twelve labors.» Hyllus, the son of Hercules, afterward killed him.

Eusden, ūs'dĕn, **Laurence,** English poet: b. Spofforth, Yorkshire (?), 1688; d. Coningsby, Lincolnshire, 27 Sept. 1730. He attracted much attention by his ‹Original Poems› (1714); ‹Ode for the New Year› (1720), and other poems, resulting in his appointment as poet laureate in 1718.

Eusebius (ū-sē'bĭ-ŭs) **of Caesare'a,** surnamed Pamphili, Church historian: b. probably, Cæsarea, Palestine, 264 A.D.; d. there about 349. He is known as Eusebius Cæsariensis and Eusebius Pamphili, that is, Pamphilus's Eusebius — a style assumed after the martyrdom of his instructor, Saint Pamphilus. He was chosen bishop of Cæsarea 314. Though he never subscribed to the views held by Arius and the Arians regarding the Godhead of Christ, he was always friendly toward them and thus incurred censure as being at best a Semi-Arian. Before the rise of Arianism he wrote a spirited defense of the Christian faith in refutation of a book by one Hierocles, who contended that the noted impostor, Apollonius of Tyana, was superior to Jesus Christ in sanctity and in miraculous powers. Eusebius wrote two treatises which have come down to our time: (1) the ‹Preparation,› and (2) the ‹Demonstration of the Gospel,› usually designated by their Latin titles, ‹Præparatio Evangelica,› ‹Demonstratio Evangelica.› The argument of the former is the groundlessness of idolatry, the impostures of the oracles, the monstrous impieties of the heathen mythology and theology; and the author shows that the doctrine of the unity of the Godhead, and the truth of his revealed religion is as ancient as the world. In the ‹Demonstratio› the argument is that the law and the prophecies of the Jewish scriptures clearly foreshow Jesus Christ and the Gospel. Of his other works extant the chief is his ‹History of the Church, from the Time of Its Founder to the year 323.› See Schöne, ‹Die Weltchronik des Eusebius in ihrer Bearbeitung durch Hieronymus› (1900).

Eusebius of Em'esa, Greek ecclesiastic: b. Edessa; d. Antioch about 360. He studied under Eusebius of Cæsarea, and at Alexandria and Antioch. Averse to all theological controversies, he declined the bishopric of Alexandria vacant by the deposition of Athanasius. He was afterward, however, appointed bishop of Emesa, in Syria, but was twice driven away by his flock, who accused him of sorcery on account of his astronomical studies. The homilies extant under his name are probably spurious.

Eusebius of Nicome'dia, Arian bishop: d. Constantinople 342. He was appointed bishop of Beryta (Beirut) in Syria, and afterward of Nicomedia. He appeared as the defender of Arius at the Council of Niçe, and afterward placed himself at the head of the Arian party. He baptized the Emperor Constantine in 337, and became patriarch of Constantinople in 339.

Eustachian (ū-stā'kĭ-ạn) **Tube,** in anatomy, a canal leading from the pharynx to the tympanum of the ear; named for the Italian anatomist, Eustachio. See Ear.

Eustachio, Bartolommeo, bär-tō-lōm-mā'ō â-oos-tä'kē-ō, Italian physician and anatomist: b. San Severino, Italy, soon after 1500; d. August 1574. He devoted himself to medical science and in particular to anatomy, which he much enriched by his researches. Among his discoveries were the Eustachian tube and the Eustachian valve of the heat. His 'Tabulæ Anatomicæ' was published 1714.

Eustathius (ūs-tā'thĭ-ūs) **of Thessalonica,** Greek scholar: b. Constantinople; d. Thessalonica 1198. He was at first a monk, then a deacon and teacher of rhetoric in his native city; he was archbishop of Thessalonica from 1160, and of Myra from 1174, and died at an advanced age. Eustathius was profoundly versed in the ancient classic authors. His most important work is his commentary on Homer (1st ed. 1542–50). His commentary on Dionysius was first printed at Paris (1547). Of his commentary on Pindar, only the 'Procemium' has come down to us; a part of his theological and historical treatises, letters, etc., was published by Tafel in 1832.

Eusta'tius, Saint, one of the Leeward Islands. See Saint Eustatius.

Eus'tis, James Biddle, American diplomatist: b. New Orleans, La., 27 Aug. 1834; d. Newport, R. I., 9 Sept. 1899. He was admitted to the bar in 1856 and practised in New Orleans till the Civil War broke out. He then entered the Confederate army and served as judge-advocate on the staffs of Gens. Magruder and J. E. Johnston till the close of the war. He was elected United States senator in 1876, but not given his seat till late in 1877; and was professor of civil law in the University of Louisiana in 1879–84, when he was again elected senator. In March 1893, he was appointed United States minister to France, and on the expiration of his term, in 1897, resumed practice in New York. He translated into English the 'Institutes of Justinian,' and Guizot's 'History of Civilization.'

Eustis, William, American physician and politician: b. Cambridge, Mass., 10 June 1753; d. Boston 6 Feb. 1825. He served as a surgeon in the American army during the Revolution, and subsequently practised medicine in Boston. He was a member of Congress 1801–5 and 1820–3; was secretary of war 1809–13; and governor of Massachusetts in 1823–5.

Eusto'ma, a genus of herbs of the gentian family, which comprises two species, natives of the Southern States, Mexico and the West Indies. The most common species is Russell's Eustoma (*E. russellianum*), which grows on the prairies from Nebraska to Louisiana, Texas and Mexico. The flowers are purple, bell-shaped, sometimes three inches in diameter.

Eutaw, ū'tâ, Ala., town, county-seat of Greene County; on the Alabama G. S. R.R.; about 95 miles southwest of Birmingham. It was settled in 1838, named in honor of the battle of Eutaw Springs, S. C. (1781), where the American forces, commanded by Gen. Greene, gained a victory. It is in a rich agricultural region. Pop. (1910) 1,001.

Eutaw Springs, a small tributary of the Santee River in Charleston County, S. C. It is noted for the battle fought on its banks in 1781. See Eutaw Springs, Battle of

Eutaw Springs, Battle of, 8 Sept. 1781, in the Revolution. Tactically a drawn battle, in results it was an important American victory, winning the object of Greene's campaign; as the British shortly abandoned interior South Carolina, retiring to Charleston. Greene, having captured 96, stole on the British at Eutaw, some 2,300, under Gen. Stuart, and attacked suddenly at 4 A.M. He had about 2,000 men, part militia, but with Marion and Pickens for commanders; while the regulars were the famous Marylanders under Howard and Hardman, Virginians under Campbell, North Carolinians under Sumner, and the remnant of the brave Delaware men; with William Washington, R. H. Lee, and Pleasant Henderson for cavalry leaders. The British had one line; the right on Eutaw Creek, the left in the air. The Americans had two, besides the reserves; the militia in front, who fought desperately and fired in some cases 17 rounds before giving way. Then the regulars rushed forward and swept the British line off the field; but gaining their camp, stopped to plunder it, and though rallied, could not drive the British from the strong positions they had taken. In assailing a brick house, Greene's guns were captured and he lost many of his best men; and a charge of Col. Washington's was repulsed and himself taken prisoner. Greene was obliged to retreat; but Stuart decamped in the night. The American loss was 408 regulars killed and wounded, militia probably at least 150; British, 453 killed and wounded, 257 missing.

Euterpe, ū-tėr'pē, one of the Muses, considered as presiding over lyric poetry. The invention of the flute is ascribed to her. She is usually represented as a virgin crowned with flowers, having a flute in her hand, or with various instruments about her. As her name denotes, she is the inspirer of pleasure. (See Muses). In botany, *Euterpe* is a genus of palms found in South America and the West Indies, and embracing seven or eight species. Some specimens attain a height of nearly 100 feet. The wood of *E. oleracea* is used for flooring. Its fruit, as also that of *E. edulis,* is edible; and the latter species furnishes assai (q.v.). Euterpe in astronomy is an asteroid (No. 27), discovered by Hind in 1853.

Eutha'mia, a genus of *Compositæ,* which includes some of the golden-rods (q.v.).

Euthanasia, ū-thạ-nā'sĭ-ạ, means, in Greek, being happy or opportune in the time of one's death. The correlative adjective is applied in Greek literature to a man who died for his country, and it has been translated by the Latin historian «felix opportunitate mortis.» The term euthanasia has recently been employed by some scientific men in advocating the reasonableness of relieving the sufferings of those afflicted with incurable diseases by administering to them anæsthetics or narcotics in sufficient doses to prove fatal.

Eutro'pius, Flavius, Latin historian, who, as he himself informs us, bore arms under the Emperor Julian. The place of his birth and his history are unknown to us. He flourished about 360 A.D. His abridgment of the history of Rome 'Breviarium Historiæ Romanæ,' written in a perspicuous style, reaches from the foundation of the city to the time of the Emperor Valens, to whom it is dedicated. The best editions are those of Droysen (1878), Rühl (1887).

Eutyches, ū'tĭ-kēz, heresiarch of the Eastern Church, who flourished in the 5th century. He was a priest and archimandrite or prior of a monastery in Constantinople; was the founder of the religious sect called after him Eutychians, but also Monophysites, as believing that in Jesus Christ was but one nature, and that the Divine: *μόνος, singularis,* single, *φύσις,* nature. The Council of Ephesus (431) having declared that in Jesus Christ were united the divine and human nature, Eutyches was condemned as a heretic by a synod of bishops held in Constantinople 448, but the next year the «Robber Synod» of Ephesus, controlled by Dioscorus, patriarch of Alexandria, reversed that judgment. In 451 the General Council of Chalcedon annulled the decrees of the Robber Synod, excommunicated Eutyches and formulated the Catholic doctrine regarding the hipostatic union of the divine and human natures in Christ. Eutyches died in exile. His doctrine took fast root in Syria, Armenia, Mesopotamia, Egypt and Ethiopia, and in those countries the Monophysite Churches are strong to this day. See MONOPHYSITES.

Euxanthic (ŭk-săn'thĭk) **Acid** ($C_{21}H_{18}O_{11}$), called also **Purreic Acid,** an acid obtained from purree, or Indian yellow. With the alkalies and earths, it forms soluble yellow compounds.

Euxenite, ŭk'sē-nīt, a rare Norwegian mineral, essentially a niobate and titanate of yttria, erbia, ceria, and uranium. It sometimes contains iron calcium, and germanium, while water is always present. It occurs in orthorhombic crystals, but usually it is massive. It has a hardness of 5.5, a specific gravity of 4.6 to 5.1, a brilliant metallic-vitreous lustre, and a brownish-black color, showing a reddish-brown translucence in thin slivers.

Euxine, ŭk'sĭn, the ancient name for the Black Sea.

Eva, Little, a beautiful child, who becomes the friend and consoler of Uncle Tom in Harriet Beecher Stowe's novel 'Uncle Tom's Cabin.' Her early death forms one of the climaxes in that affecting story.

Evadne, e-văd'nē, in Greek fable, the daughter of Mars and Thebe, who threw herself into the funeral pile of her husband, Cateneus.

Evagoras, ẹ-văg'ō-rạs, **king of Salamis in** Cyprus, flourished about the beginning of the 4th century B.C. His family had been expelled by a Phœnician exile. Evagoras recovered the kingdom in 410 B.C., and endeavored to restore in it the Hellenic customs and civilization. He was friendly with the Athenians, and in return for his services a statue was erected to him at Athens. His increasing power attracted the jealousy of the Persian king, Artaxerxes II., who declared war against him and besieged Evagoras in his capital. He was saved only by the dissensions of his enemies, and was able to conclude in 385 a peace by which the sovereignty of Salamis was secured to him.

Evagrius (ẹ-văg'rĭ-ŭs) **Scholas'ticus,** Syrian Church historian: b. Epiphonia about 536; d. after 594. He wrote the history of the Church in continuation of the ecclesiastical histories of Eusebius, Socrates, Theodoret and Sozomen from 431, the date of the Council of Ephesus, to 594. His surname, Scholasticus, indicates that he was by profession (probably at Antioch) an advocate, for such at that time was a usual meaning of the word: he was legal adviser to Gregory, patriarch of Antioch, who commended him for his fidelity and learning to the emperor, Tiberius Absimarus, and obtained his promotion to a judicial office. In recognition of his eminent integrity as an official of the empire his second marriage was made the occasion of a public festival; which, however, had a disastrous ending, for it was interrupted by a violent earthquake, which caused the loss of thousands of lives.

Evan'der, in classical legend, the civilizer of Latium, the son, according to one account, of Hermes and an Arcadian nymph. About 60 years before the Trojan war he established himself in Latium, and built, at the foot of the Palatine Hill, on the banks of the Tiber, a town, to which he gave the name of Pallantium. The Roman legends represent him as teaching the Latins the use of the alphabet, and the arts of agriculture and music, softening their fierce manners by the introduction of more humane laws, and introducing among them the worship of the Lycæan Pan, Heracles, Demeter, etc. In the Æneid Virgil brings his hero Æneas into connection with Evander, who gives him a favorable reception, and becomes his ally against the Latins. Divine honors were paid to Evander by the inhabitants of Pallantium in Arcadia.

Evald, ā'vält. See EWALD.

Evangel'ical, a word literally signifying «pertaining to the gospel,» and used in different senses. In one of its senses it is a term used to qualify certain doctrinal opinions, especially strong views on the question of the atonement, justification by faith, and allied doctrines. In this sense the word, when applied to a whole church, is in Scotland almost synonymous with orthodox; and in the United States it has much the same significance, in contrast to the words «liberal» and «rationalistic.» In England the Evangelical or Low Church party is looked upon as extreme in its views, and is distinguished from the orthodox party, which holds the doctrines above specified in a more moderate form. When used in a less general sense something more is implied in the word. It indicates peculiar attachment to sound doctrine and peculiar fervency in advocating it. In another sense the term is applied in Germany to Protestants as distinguished from Roman Catholics, inasmuch as the former recognize no standard of faith except the writings of the evangelists and the other books of the Bible, and more especially to the national Protestant Church, formed in Prussia in 1817, by a union of the Lutheran and Calvinistic churches.

Evangelical Alliance, an association of members of the different sections of the Christian Church, organized in London 19–23 Aug. 1846. At this meeting was adopted a doctrinal basis, which is, in effect, the recognition by the members of the divine inspiration, authority, and sufficiency of the Holy Scriptures; the right of private judgment in their interpretation; the unity of the Godhead, and the Trinity of persons therein; the doctrine of human depravity in consequence of the fall; the incarnation, atonement, intercession, and mediatorial reign of the Son of God; justification by faith alone; the work of the Holy Spirit in conversion and sanctification; the immortality of the soul, the resurrection of the body, and the final judgment of the world resulting in the eternal blessedness of the righteous, and the eternal punishment of the wicked; the divine institution of the Christian ministry; and the obligation and perpetuation of the ordinances of baptism and the Lord's Supper. The American branch of the alliance was organized in 1867. Conferences of the entire alliance have been held in 1851, 1855, 1857, 1861, 1867, 1873, 1879, 1885, 1891, that of 1873 having met in New York. The American branch held a conference at Chicago in October 1893. The alliance has aided largely in the promotion of religious liberty in Europe and the East.

Evangelical Association, a religious denomination founded in Pennsylvania about the beginning of the 19th century by Jacob Albright, a member of the Methodist Episcopal Church, who was born in Pennsylvania 1759, and from about 1790 traveled among the German population as an evangelist. Albright founded a society of converts in 1800, which so increased in numbers that it was finally organized in 1807 as the Evangelical Association of North America with Albright as bishop. The theology of the association as defined in its 21 articles closely resembles that of the Methodist Episcopal Church, from which, also, it differs little in government and form of worship. The Church was divided in 1891, when a minority, numbering 40,000, organized the United Evangelical Church. In 1901 the association had 27 annual conferences, including 1 in Japan, 1 in Switzerland, and 2 in Germany; 476 local and 1,088 itinerant preachers, and property valued at $6,125,430. Consult: Orwig, 'History of the Evangelical Association' (1858).

Evangelical Counsels, in Catholic theology, are distinguished from divine commandments in this, that the commandments are of universal obligation for whoever would be saved, while the Evangelical Counsels point to the readiest and surest means of attaining that end. When a certain ruler put to Jesus Christ the question: «What good thing shall I do that I may inherit life?» and received the answer: «If thou wilt enter into life, keep the commandments,» he was taught the condition of salvation which applies to all mankind. But he wanted to know whether there is not a more excellent way: he had «observed all those things from his youth up»; was there not some other «good thing» for him to do? Then Jesus prescribed to him the perfect way: «Sell all that thou hast and distribute unto the poor,» giving him one of the Evangelical Counsels, the counsel of voluntary poverty. The celibate life is commended by St. Paul as more favorable to entire devotion to the service of God than the state of marriage: that Evangelical Counsel is the principal topic of the epistle of 1 Corinthians. Finally, entire obedience is the third of those counsels — renunciation of self-will, cheerful submission to the rule of superiors. Members of the religious orders of the Catholic Church bind themselves by solemn vows to practise the three Evangelical Counsels: poverty, chastity, and obedience.

Evangelical Union, the name of a religious body, also familiarly known as the Morisonians, from the Rev. James Morison, of Kilmarnock, by whom, with three other clergymen, it was founded in Scotland in 1843. The Morisonians maintain the universality of the atonement, combining with this the doctrine of eternal personal and unconditional election. In point of church government the members of the Evangelical Union are independent. The body had in 1899 between 90 and 100 congregations, chiefly in Scotland, and 712 ministers. Consult: Ferguson, 'History of the Evangelical Union' (1876).

Evangeline, ę-văn'jĕ-lĭn, the heroine of one of Longfellow's earlier narrative poems, to which her name is given. It is written in English hexameters, and describes, although with little real topographical delineation of scenery, the deportation of the Acadians by the English government in 1775.

Evangelical Christian Science. See SABIN, OLIVER C.

Evan'gelist (a bringer of good tidings), in the New Testament, a preacher of the gospel, distinguished (Eph. iv. 11) from the apostles, prophets, pastors, and teachers. The term came ultimately to refer to only the authors of the four Gospels, but in modern times has been extended to indicate also an unattached preacher whose specific work is the arousing of personal interest in matters of religion.

Evans, Arthur John, English archæologist: b. Nash Mills, Hertfordshire, 1851. He is a son of Sir John Evans (q.v.). He was educated at Harrow, Oxford, and Göttingen, and has been keeper of the Ashmolean Museum, Oxford, from 1884. Since 1893 he has superintended archæological researches in Crete, excavating in 1900–2 the pre-historic palace of Knossos. He has published: 'Through Bosnia' (1895); 'Illyrian Letters'; 'Antiquarian Researches in Illyricum' (1883–5); 'Cretan Pictographs and Pre-Phœnician Script' (1898); 'The Mycenæan Tree and Pillar Cult' (1901); etc.

Evans, Augusta Jane. See WILSON, AUGUSTA JANE EVANS.

Evans, Clement Anselm, American lawyer: b. Stewart County, Ga., 25 Feb. 1833. He was graduated at the Augusta, Ga., Law School 1852; established himself in practice; was county judge 1854–5, and State senator 1859–60. During the Civil War he served in the Confederate army as acting major-general in the Army of Northern Virginia. After Gen. Lee's surrender he entered the Methodist Episcopal ministry, and served until 1890. He has written a 'Military History of Georgia'; and edited the 'Confederate Military History' (12 vols.).

Evans, Edward Payson, American author: b. Remsen, N. Y., 8 Dec. 1833. He has made a special study of Oriental languages; in 1884 became connected with the 'Allgemeine Zeitung,' of Munich in Europe, to which he contributed many articles on the literary, artistic, and intellectual life of the United States. He has published 'Summary of the History of German Literature' (1869); 'Progressive German Reader' (1870); 'Animal Symbolism in Ecclesiastical Architecture' (1896) 'Evolutional Ethics and Animal Psychology' (1898); etc.

Evans, Elizabeth Edson Gibson, American prose writer: b. Newport, N. H., 8 March 1833. She was married to Edward Payson Evans (q.v.) 1868. She has published: 'The Abuse of Maternity' (1875); 'Laura, an American Girl' (1884); 'A History of Religions' (1892); 'Story of Kasper Hauser' (1892); 'The Story of Louis XVII. of France' (1893); 'Transplanted Manners' (1895); 'Confession' (1895); 'Ferdinand Lassalle and Helen von Dönninger' (1897); 'The Christ Myth' (1901).

Evans, Frederick William, American writer: b. Bromyard or Leominster, England, 9 June 1808; d. Mount Lebanon, N. Y., 6 March 1893. He removed to the United States in 1820; joined the United Society of Believers (Shakers) at Mount Lebanon, N. Y., in 1830, and became an elder in that society. The best known of his works are: 'Compendium of the Origin, History, and Doctrines of the Shakers' (1859); 'Autobiography of a Shaker' (1869); 'Shaker Communism' (1871); 'The Second Appearing of Christ' (1873).

Evans, Sir George De Lacy, British general: b. Moig, Ireland, 1787; d. London 9 Jan. 1870. He entered the army in 1806, and in the beginning of 1814 was sent to America, and at the battle of Bladensburg (24 Aug. 1814) had two horses shot under him. At the head of 100 men he forced the capitol at Washington. He was twice wounded before New Orleans in December 1814, and was on that account sent home to England, where he recovered just in time to be able to join Wellington at Quatre-Bras and Waterloo. In 1846 he was raised to the rank of major-general. At the outbreak of the Crimean war he was appointed to the command of the second division of the British army, and distinguished himself at the battle of the Alma, the siege of Sebastopol, and the battle of Inkermann. For his services he received the thanks of the House of Commons, the Grand Cross of the Bath, and had the cross of a grand officer of the Legion of Honor conferred on him by Napoleon III.

Evans, Henry Clay, American politician: b. Juniata County, Pa., 18 June 1834. He served in the 51st Wisconsin Infantry, enlisting 1864, and subsequently settled in Chattanooga, Tenn., as an iron and railway-car manufacturer, and was mayor of Chattanooga for two terms. He sat in Congress in 1889–91, and was assistant postmaster-general 1889–93. His election as governor of Tennessee 1894 was disputed and the opposing Democratic candidate was seated. He stood second in the vote for vice-president at the National Republican convention 1896, was appointed United States commissioner of pensions in 1897, and became consul-general in London 1902.

Evans, Hugh Davy, American author: b Baltimore, Md., 26 April 1792; d. there 16 July 1868. He studied law, began practice in Baltimore in 1815; and became eminent as a jurist. He was editor of 'The True Catholic' 1843–56; was connected with various other papers. He was a prominent member of the Maryland Colonization Society, and prepared a code of laws for the Maryland colony in Liberia; and in 1862–64 lectured on civil and ecclesiastical law. Among his writings are: 'Essays on Pleading' (1827); 'Maryland Common-Law Practice' (1837); 'Theophilus Anglicanus' (1851); 'Essays on the Episcopate of the Protestant Episcopal Church in the United States' (1855); 'Treatise on the Christian Doctrine of Marriage' (1870).

Evans, John, American geologist: b Portsmouth, N. H., 14 Feb. 1812; d. Washington, D. C., 13 April 1861. He served on several State and Territorial geological surveys; and discovered remarkable fossil deposits in the Bad Lands of Nebraska. He was afterward commissioned by the United States government to carry on the geological surveys of Washington and Oregon.

Evans, John, American philanthropist: b. Waynesville, Ohio, 9 March 1814; d. Denver, Col., 3 July 1897. He was graduated at the medical department of Cincinnati College in 1838; in 1848 became a professor in the Rush Medical College of Chicago, in which city he accumulated a large fortune by investments in real estate. Much of this he gave to philanthropic objects. He established the Northwestern University, and endowed two chairs in it with $50,000 each. In 1862 he was appointed governor of the Colorado Territory. Later he established the University of Denver, to the construction of which he gave $200,000 and a large endowment. He gave largely for the erection of the Grace Methodist Episcopal Church in Denver, and aided almost every educational institution and Methodist Episcopal Church in the State.

Evans, Sir John, English archæologist: b. Britwell Court 17 Nov. 1823; d. 31 May 1908. His publications include: 'The Coins of Ancient Britons'; 'The Ancient Stone Implements, Weapons, and Ornaments of Great Britain and Ireland' (1872, 2d and enlarged edition 1897); 'Ancient Bronze Implements, Weapons, and Ornaments of Great Britain and Ireland' (1881). From 1878 till 1896 Sir John Evans was treasurer of the Royal Society, and he presided over the Toronto meeting of the British Association in 1897. He has also been president of the Geological Society (1874–6), of the Numismatic Society (1874–96), and of the Society of Antiquaries (1885–92), and he is a corresponding member of the Institute of France. His great work on stone implements received a prize from the French Academy, and both it and his other work on bronze implements were translated and published in Paris shortly after they appeared in England.

Evans, Mary Ann, or **Marian.** **See Eliot, George.**

Evans, Oliver, American inventor: b. Newport, Del., 1755; d. New York 25 April 1819. In 1777 he invented a machine for making card-teeth. Two years later he entered into business with his brothers, who were millers, and in a short time invented the elevator, the conveyor, the drill, the hopper-boy, and the descender, the application of which two mills worked by water-power effected a revolution in the manufacture of flour. For some years after these improvements were perfected, the inventor found much difficulty in bringing them into use, although in his own mill the economy of time and labor which they effected was very manifest. About 1799 or 1800 he set about the construction of a steam-carriage; but finding that his steam-engine differed in form as well as in principle from those in use, it occurred to him that it could be patented and applied to mills more profitably than to carriages; and in this he was completely successful. This was the first steam-engine constructed on the high-pressure principle; and to Evans, who had conceived the idea of it in early life, and in 1787 and again in 1794-5 had sent to England drawings and specifications, the merit of the invention belongs, although it has been common to assign it to Vivian and Trevethick, who had had access to Evans' plans. In 1803-4, by order of the board of health of Philadelphia, he constructed the first steam dredging machine used in America, consisting of a flat scow with a small engine to work the machinery for raising the mud. Evans also invented the "Cornish boiler." He wrote: 'The Young Engineer's Guide'; and 'Miller and Millwright's Guide.'

Evans, Robley Dunglison, American naval officer: b. Floyd Court House, Va., 18 Aug. 1846; d. Washington 3 Jan. 1912. He was appointed to the U. S. Naval Academy from Utah in 1860, promoted ensign in 1863, and in 1864-5 was on board the Powhatan of the North Atlantic blockading squadron. He participated in both attacks on Fort Fisher, in 1868 was commissioned lieutenant-commander, in 1870-1 was on duty at the navy yard, Washington, in 1871-2 at the Naval Academy. Having served in 1873-6 successively on the Shenandoah and the Congress, of the European station, he was made commander in 1878; in 1891-2 was in command of the Yorktown at Valparaiso, Chile, and in 1893 became captain. During the Spanish-American war he was in command of the Iowa, and at the naval battle of Santiago he took an important part in the destruction of Cervera's fleet. In 1901 he was commissioned rear-admiral; in 1902 was made commander of the Asiatic fleet with the flagship Kentucky; commanded the Atlantic fleet, 1905-7, taking it in 1907, as commander-in-chief, on tour of the world. Was retired 18 Aug. 1908. He published 'A Sailor's Log' (1901).

Evans, Thomas Williams, American dentist: b. Philadelphia 23 Dec. 1823; d. Paris 14 Nov. 1896. He studied dentistry and practiced in Maryland and later in Lancaster, Pa., and made a specialty of saving teeth by filling. In seeking a substitute for gold foil he mixed rubber and sulphur, which made a black substance instead of a white one. Because of the unfavorable color he laid the substance aside and gave it no more thought till his mixture was used by others for producing commercial gutta-percha, which he declared he had discovered. In 1848 he went by invitation to Paris as the most skilful American dentist, to attend to the teeth of President Louis Napoleon. During his career in Paris he accumulated a very large fortune. He also won an international reputation as an expert in military sanitation, and was one of the founders of the Red Cross Society. His home was the refuge of the Empress Eugénie from the mob on the night of 4 Sept. 1870. Dressed in his wife's clothes, she was taken by him to the Normandy coast, where he secured her escape to England. He bequeathed all of his fortune, estimated at from $8,000,000 to $12,000,000, excepting $250,000, to establish a museum and institute in Philadelphia.

Evans, William, Canadian agriculturist and author: b. Cavan, Ireland, 1786; d. Montreal, Canada, 1857. He emigrated from Ireland to Canada in 1819, became secretary of the first agricultural society in Montreal, in 1837 contributed a series of letters on agriculture to the *Courier*, and subsequently established the 'Canadian Quarterly' and the 'Agriculturist and Industrial Magazine.' In 1842 he edited in Toronto the 'British American Cultivator,' and in 1843 founded the 'Canadian Agricultural Journal' at Montreal. He became secretary and treasurer of the board of agriculture, Lower Canada, in 1853. His writings include 'The Theory and Practice of Agriculture' (1835).

Ev'anston, Ill., city in Cook County, on Lake Michigan, and on the Chicago & N. W., and the Chicago, M. & St. P. R.R.'s; 12 miles north of Chicago. It includes the villages of Rogers Park and South Evanston; is delightfully laid out; and has gas and electric light plants; electric and elevated railroads to Chicago; Holly system of waterworks, weekly newspapers, and a national bank. It is the seat of Northwestern University (M. E.) founded in 1854, largely endowed and of high repute, with a library of 25,000 volumes and a museum. It is the seat also of the Garrett Biblical Institute, Winchell Academy, of the Evaston College for Women, founded in 1871, and the Visitation Academy. The Dearborn Observatory was transferred here from Chicago in 1888, and dedicated the following year as a department of Northwestern University. Evanston was the home of Frances Willard (q.v.). It is really a residential suburb of Chicago. Pop. (1910) 24,978.

Evanston, Wyo., city and county-seat of Uinta County, 76 miles east of Ogden; on the Bear River and the Union Pacific Railway. There are valuable coal mines in the vicinity, and the surrounding region is also largely devoted to stock-farming and agriculture. Oil has been discovered in the neighborhood. Among the local industries are a large flouring-mill and railway repair shops. The State Asylum for the Insane is situated here. Pop. (1910) 2,583.

Evansville, Ind., a city and part of entry of Vanderburg County, of which it is the county-seat, about 185 miles west of Louisville, 192 miles northeast of Cairo, and 180 miles southwest of Indianapolis; on the Ohio River, and the Louisville, E. & St. L., the Louisville & N., the Evansville & T. H., and other railways. It is pleasantly located on a high bank of the river.

Industries, etc.—Evansville is the chief shipping point for southwestern Indiana, and ranks highly among the commercial centres of the State. According to the government census for 1900 there were in that year 705 establishments representing manufacturing and mechanical industries, with a capital of $10,059,375 and buildings valued at $1,913,592, employing the average number of 7,279 wage-earners with total wages of $2,883,975. The cost of materials used was $7,504,660, and the value of products $14,193,320. The neighboring region abounds in coal and the local coal trade is a large one. There is also an important trade in flour, pork, tobacco, grain, and timber. There are machine-shops and foundries, plow-works, furniture factories, flouring-mills, and manufactures of cottons and woolens, brick and tile, pottery, terra-cotta and fire-clay products, malt liquors, and saddlery and harness. The wharfage and shipping facilities are excellent.

Public Institutions, Buildings, etc.— The prominent buildings include the United States custom-house, the court-house, the city-hall, the Willard Library, the State Hospital for the Insane, Evans Temperance Hall, and the United States Marine Hospital. There are also three parks. Daily and weekly newspapers are published.

History, Government, etc.— Evansville was founded by Gen. R. M. Evans in 1816, became the county-seat of Vanderburg County in 1819, and was incorporated in 1847. The government is administered by a charter of 3 March 1893, with amendments of 11 March 1895. This instrument provides for a mayor, elected for four years, and a common council, one member from each ward for one year and four councilmen at large for two years. The annual expenditure of the municipality is about $700,000, the annual income about $940,000. The municipality owns the waterworks, which are operated at a yearly expense of about $30,000. Pop. (1890) 50,750; (1900) 59,007; (1910) 69,647.

Evansville, Wis., a village of Rock County, 17 miles northwest of Janesville and 22 miles south by east of Madison; on the Chicago & Northwestern railway. Among its industries are an extensive wind-mill factory, an iron-foundry, and two large tobacco warehouses. Pop. (1910) 2,061.

Evapora'tion (Lat. *evaporatio,* from *evaporare,* to emit vapor), the formation of vapor at the free surface of a liquid. In evaporation a portion of the liquid escapes in the gaseous form from the general mass, and, rising into the space, spreads through it according to the laws of diffusion of gases. Supposing the temperature of the space above the liquid to be uniform, the evaporation proceeds (provided there is a sufficient quantity of liquid) until the space is uniformly filled with vapor. A space thus filled with the maximum quantity of vapor corresponding to the temperature of it is said to be saturated. If the dimensions of the space be diminished, a portion of the vapor is forced to condense; if the temperature of the space falls, a portion of the vapor condenses also; while if the temperature of the space is increased, the dimensions remaining unchanged, the space ceases to be saturated, because the quantity of the vapor that corresponds to saturation is greater the higher the temperature. When there is not a sufficient quantity of liquid present to saturate the space completely, the whole of the liquid evaporates, and the vapor diffuses uniformly through the space. The space is then said to be non-saturated. See BOILING POINT; VAPOR.

Evart, Mich., a village of Osceola County, 60 miles east of Ludington, and 76 miles west-northwest of East Saginaw; on the Muskegon River and the Flint & Père Marquette railway. It is located in the centre of an important lumbering region, and has, besides saw-mills and shingle manufactories, a machine-shop and a foundry. Pop. (1910) 1,386.

Evarts, Jeremiah, American editor and missionary secretary: b. Sunderland, Vt., 3 Feb. 1781; d. Charleston, S. C., 10 May 1831. He was graduated at Yale 1802, and settled in New Haven as a lawyer. His life was largely devoted to the interests of missions, he being editor of the 'Missionary Herald' for a long term, and corresponding secretary of the American Board of Commissions for Foreign Missions 1821–31.

Evarts, William Maxwell, American lawyer and statesman: b. Boston, Mass., 6 Feb. 1818; d. New York 28 Feb. 1901. He was graduated from Yale in 1837, studied law in the Harvard law school and the office of Daniel Lord of New York, in 1841 was admitted to the bar, and in 1849–53 was assistant district attorney in New York. In 1851 he was successful in the conduct of the prosecution of the Cuban filibusters of the Cleopatra expedition. He was retained in 1857 and 1860 to argue the Lemmon slave case on behalf of the State of New York against Charles O'Conor, council for Virginia. An active and prominent Republican, he made the speech nominating Seward for the Presidency at the Republican national convention in Chicago in 1860, though subsequently moving to make the nomination of Lincoln unanimous. In 1861 he and Horace Greeley (q.v.) were rival candidates before the State legislature for appointment to the senatorship vacated by Seward, newly made secretary of state. As a compromise, Ira Harris was finally appointed. Evarts' legal knowledge was frequently employed in the service of the administration. On behalf of the government he conducted numerous important cases. Among such were that before the Supreme Court to establish the right of the United States during the Civil War to deal with the captured ships as maritime prizes (1862), and that maintaining the unconstitutional character of the State laws taxing United States bonds or stock of the national banks without authorization of Congress (1865–6). He was principal counsel for Andrew Johnson (q.v.) in the President's trial for impeachment, and by his lofty judicial argument contributed much to a result which has since been regarded as most fortunate. He then went into Johnson's cabinet as attorney-general for the remaining year of the term. In 1872 he was chief counsel for the United States before the Geneva tribunal for settlement of the Alabama claims (q.v.). As chief counsel for the Republican party before the electoral commission (q.v.) that settled the Hayes-Tilden Presidential dispute, Evarts based his argument on the constitutional idea that sovereign States must conduct their elections and govern themselves without Federal interference, pointing out that the electoral returns from Louisiana revealed the choice of Hayes electors. During Hayes' administration he was secretary of state. He made, in 1880, a report upon the matter of American control of a trans-isthmian canal, whether at Nicaragua or Panama. His administration of the office was marked by skill in diplomatic questions, the improvement of the consular service, and the publication of consular reports on the economic and commercial status of foreign lands. In 1881 he was a delegate to the international monetary conference at Paris, and in 1885 entered the United States Senate, his term expiring 3 March 1891. He was the senior partner in the law firm of Evarts, Choate, and Beaman, and was frequently retained in important corporation cases. While in the Senate he made several noteworthy speeches, and he also pronounced many distinguished occasional addresses, including the Centennial oration at Philadelphia in 1876.

Eve. See ADAM.

Eve, Paul Fitzsimons, American physician: b. near Augusta, Ga., 27 June 1806; d. Nashville, Tenn., 3 Nov. 1877. He was graduated from the University of Georgia in 1826, and from the medical department of the University of Pennsylvania in 1828; studied also for several years in Europe; and was an ambulance surgeon during the French revolution of 1830, and a regimental surgeon in the Polish war of 1831. In 1832 he became professor of surgery in the Medical College of Georgia; and he obtained a similar chair in Louisville University (Ky.) in 1849 and in Nashville University (Tenn.) in 1850. Made surgeon-general of Tennessee in 1861, he was hospital surgeon on the medical examining board during the War, in 1868 was appointed professor of surgery in the Missouri Medical College (Saint Louis), and in 1870 in the University of Nashville. For a time he was editor of the 'Southern Medical and Surgical Journal,' and assisted in editing the Nashville 'Medical and Surgical Journal.' He published 'Remarkable Cases in Surgery' (1857) and other works.

Evec'tion (Lat. *evectio,* «a turning upward»), the second inequality in the motion of the moon, due to the attraction of the moon by the sun. Owing to the evection the position of the moon may vary 1.25°. It was discovered by Hipparchus nearly 200 years before the Christian era, and more completely determined by Ptolemy.

Eveli'na, a novel published 1778, by Frances Burney. In 'Evelina; or, the History of a Young Lady's Entrance into the World,' Miss Burney, describing the experiences of her heroine in London, gives a vivid picture of the manners and customs of the 18th century. The story is told by letters, principally those of Evelina to her guardian.

Evelyn, ĕv'ĕ-lĭn, **John,** English writer: b. Wotton, Surrey, 31 Oct. 1620; d. there 27 Feb. 1706. After completing his course at Oxford he began to study law at the Middle Temple. He made some efforts in favor of the royal cause in 1659, on which account he was much favored by Charles II. after his restoration. In 1662 he published 'Sculptura, or the History and Art of Chalcography or Engraving on Copper.' On the foundation of the Royal Society he was nominated one of the first Fellows, and at its meetings he read a discourse on forest-trees, which formed the basis of his most celebrated publication, 'Sylva, or a Discourse of Forest-trees' (1664). He continued in favor at court after the revolution, and was made treasurer of the Greenwich Hospital. He lived for many years at Sayes Court, Deptford, and subsequently succeeded to his brother's estate of Wotton, his life being that of a loyal, worthy, public-spirited country gentleman. Evelyn left a most interesting diary, picturing his life from 1641 to 1706, first published with his correspondence in 1818. A new edition of the 'Diary' was issued in 1827; another, with life, by Wheatley, in 1879.

Evening Grosbeak, a large finch (*Coccothraustes vespertinus*) of western North America. It is olivaceous, with the crown, wings, tail and feet black; forehead and rump yellow; bill yellowish, and a white patch on the wing. It inhabits the forests of northwestern Canada and the Rocky Mountain region, occasionally coming south into the upper Mississippi valley in winter. It has the general habits of its relative, the pine grosbeak (q.v.), and is noted for its rich song.

Evening Primrose, the common name of American plants belonging to the different genera of the natural order *Onagraceæ,* or evening primrose family. They are annual herbs, the yellow flowers opening either during the night or at evening. There are upward of 40 species to which the name is applied, nearly all natives of North America, but many of them naturalized in Europe, particularly in England, where the small-flowered evening primrose (*Onagra cruciata*) formerly *Œnotherabiennis,* is a much prized garden plant.

Evening or **Night Schools,** schools in which instruction is given to pupils debarred, generally by reason of being wage-earners, from the advantages of the day schools. Evening schools arose at a time when compulsory education was not as wide-spread as at present and when more children were consequently growing up without instruction. Beginning with the idea of imparting the more rudimentary branches, such schools have extended their scope until in some cases they form departments of institutions devoted to the study of art, science, or technology. In some of its wider aspects their work has become allied to the university extension movement.

Central Europe.— The evening schools in central Europe are largely the outgrowth of Sunday-schools which shortly after the middle of the 18th century began to add elementary secular instruction to religious teaching. The school age limit being less than at present, a review or continuation of school studies seemed of great importance. In Germany, beginning with lessons in arithmetic and the mother tongue, the range of instruction gradually widened. Some states made attendance obligatory at such Sunday-schools in certain cases. At present the term *Fortbildungsschulen* (literally «further developing schools») is applied in Germany and Switzerland to schools intended for pupils who have passed the elementary school age and yet who study the elementary branches. These *Fortbildungsschulen* are open only in winter and rarely require more than six hours of attendance in the week. Their object is to give boys a practical turn of mind by instruction fitted to bear upon their future callings. They do not furnish instruction in foreign or dead languages or the higher mathematics. In Switzerland, all the 25 cantons have systems of *Fortbildungsschulen* held on Sundays, holidays, and in the evening. The evening schools of France, now numbering many thousands, appear not to date back farther than 1820. The tendency is toward technical training rather than liberal studies, but there are also evening classes or lectures open to those who desire a broader culture.

Great Britain.— In 1806 a benevolent association founded an evening school in Bristol, England, for young persons who were working for a living. In 1811 a school for adults was started in Bala, Wales, and others shortly followed in London and other towns. Such schools were originally supported by private benevolence or local funds, but the government after a time saw the wisdom of aiding them by grants. Since 1861 this aid has been greatly increased, but is not intended to supersede local effort. According to regulations issued by the Board of Education of Great Britain for the school year ending 31 July 1903, local funds are expected to meet 25 per cent of expenditure for the evening schools, and such expenditure must be approved by the board. The schools must not be conducted for private profit. They are under supervision and examination by the board, are subject to its examinations, and must report to it. Schools charging no fees are not generally recognized. Instruction must begin after 4 P.M. or on Saturday after 1 P.M. Students under 12 are not admitted nor those who attend day schools under government inspection (art students being excepted). Not more than 160 hours of instruction may be counted for any student in one year. The courses are as follows: (1) Literary and commercial; (2) art; (3) manual instruction; (4) mathematics and science; (5) home occupations and industries. The last course is largely for girls and includes «home nursing.» The boys may take a course in ambulance training, in gardening, etc. Throughout London the evening schools give instruction in gymnastics, and swimming and life-saving methods have been taught to some of the pupils. Evening classes have been held in London at various institutions such as University College, King's College, South Kensington Museum, etc. In the so-called provincial colleges evening classes constitute an important part of the work. Special schools give instruction in commercial branches, courses for women, art, technology, and advanced science. The Education Department of Great Britain reported 28 Feb. 1900 for the evening schools of England and Wales 5,008 schools inspected, 474,563 pupils enrolled and grants equivalent to $914,370.

In Scotland the parliamentary grants for evening schools are administered by the Scotch Education Department, and are used as in England to supplement locally raised funds. The courses of study cover about the same ground. Gaelic is found on the curriculum, and agriculture, horticulture, navigation, military drill, and swimming may all be learned. The evening schools of Ireland are subject to more restrictions and are less flourishing than those of Great Britain.

United States.— The first successful evening schools of the United States began near the middle of the 19th century, although an attempt without permanent results was made in New York in 1834. Boston and other large cities soon followed and evening schools gradually became a recognized part of the common school system. The aims of the pupils in the evening schools being generally very practical and their minds more mature, the methods and subjects of instruction are varied from those of the day schools. Branches relating to commercial and industrial occupations are naturally preferred. Free evening schools for instruction in drawing exist in some cities and drawing is included in the curriculum of some of the regular schools. Evening high schools have become common and in addition to these extensions of the public school system, various important institutions, such as Cooper Union, New York; the Maryland Institute, Baltimore, and the Drexel Institute, Philadelphia, offer evening courses of a highly varied and very valuable character, and of a range resembling that of the day classes. Free lectures also connect such schools with university extension methods. One disadvantage recognized in evening classes for industrial workers, both here and abroad, is the fact that the fatigue consequent upon the physical exertion of the day prevents mental alertness and freshness. The evening schools conducted by the Young Men's Christian Association in the United States instruct 26,000 students. Their finishing certificates are accepted in about 100 institutions of college grade. The Young Men's Christian Association Evening Institute of Boston and the McDonald Educational Institute of Cincinnati, under the same auspices, have night law schools. In the 539 business and commercial schools reporting to the United States Bureau of Education in 1910, there were 34,032 students in evening classes. The evening schools connected with the city school systems of the United States reported in 1910, for cities of over 8,000 inhabitants, a total of 227 cities, 9,326 teachers, and 374,364 pupils, the greatest number of schools being in the nine North Atlantic States, and the smallest number in the nine South Central States and Territories.

Evening Star (also called **Hesperus** and **Vesper**), the name given to any one of the planets seen above the horizon before midnight: especially applied to the planet Venus on account of its brightness. Mars, Jupiter, and Saturn are the other chief evening stars.

Everdingen, ev'er-dĭng-en, **Aldart** or **Allart van,** Dutch landscape painter: b. Alkmaar 1621; d. Amsterdam November 1675. His sea pieces, in which he represents the disturbed elements with great truth to nature, are particularly celebrated. In forest scenes, too, he was a master. He is known also as an able engraver by his plates to 'Renard the Fox.'

Ev'erest, Mount, or **Gaurisankar,** that is, Mountain of the Gods, the highest known mountain in the world, is a peak of the Himalayas, in Nepal. It is 29,012 feet high, or about five and one half miles. It was named in honor of Sir George Everest, an Englishman who for a time was surveyor-general of India.

Ev'erett, Alexander Hill, American diplomatist: b. Boston, Mass., 19 March 1792; d. Canton, China, 29 May 1847. Graduated from Harvard in 1806, he was admitted to the bar, and, after serving as *chargé d'affaires* at The Hague, was minister to Spain in 1825–9. He then became editor of the 'North American Review,' and was elected to the State legislature of Massachusetts. In 1840 he was appointed special agent to Cuba, and from 1845 until his death he was a commissioner to China. His work on 'Europe, or a General Survey of the Political Situation of the Principal Powers, with Conjectures on their Future Prospects' (1822) was highly esteemed in its time, and was published in French, Spanish, and German. In 1827 appeared his somewhat similar book on 'America.' Among his other volumes are 'Critical and Miscellaneous Essays' (1st series, 1845; 2nd series, 1847) and 'Poems' (1845). He wrote also biographies of Patrick Henry and Joseph Warren for Sparks' series of 'American Biography.' To the 'North American Review' he contributed a large number of essays. While resident in Cuba he was appointed to the presidency of Jefferson College, but ill health compelled his return north. He was at first a member of the National Republican or Whig party, but later supported Jackson.

Everett, Charles Carroll, American Unitarian clergyman: b. Brunswick, Me., 19 June 1829; d. Cambridge, Mass., 17 Oct. 1900. He was graduated at Bowdoin College; and studied at the University of Berlin. He returned to Bowdoin College, where he was tutor for two years, librarian for five, and professor of modern languages 1855–7. He was ordained pastor of the Independent Unitarian Congregational Church in Bangor, Me., 1859, but resigned in 1869 to become professor of theology in Harvard Divinity School, and was dean of the school from 1879 till his death. Among his published works are: 'The Science of Thought' (1869); 'Religion Before Christianity' (1883); 'Fichte's Science of Knowledge' (1884); 'Poetry, Comedy, and Duty' (1888); 'Ethics for Young People' (1891); and 'The Gospel of Paul' (1893).

Everett, David, American writer: b. Princeton, Mass., 29 March 1770; d. Marietta, Ohio, 21 Dec. 1813. He studied law in Boston, and while there wrote for 'Russell's Gazette' and a literary paper called the 'Nightingale.' He edited the 'Boston Patriot' (1809), and the 'Pilot' (1812). His works include: 'The Rights and Duties of Nations,' an essay; 'Darenzel, or the Persian Patriot,' a tragedy (1800); 'Common Sense in Déshabille, or the Farmer's Monitor.' He wrote the well-known lines beginning —

You'd scarce expect one of my age
To speak in public on the stage.

Everett, Edward, American statesman and orator, brother of A. H. Everett (q.v.): b. Dorchester, Mass., 11 April 1794; d. Boston 15 Jan. 1865. Graduated from Harvard in 1811, he pursued studies in divinity, became in 1813 pastor of the Unitarian Church, Brattle Street, Boston, and in 1814 published his 'Defence of Christianity' in reply to the 'Grounds of Christianity Examined' of George B. English. In 1814 he was also chosen to occupy the newly established chair of Greek literature. To qualify himself for the post he went to Europe in 1815 for a course of travel and study. He was for two years at the University of Göttingen, and later sojourned in France, England, Italy and Greece. In 1819 he returned to enter on the duties of his professorship. He became also in 1820 the editor of the 'North American Review,' and in 1820–4 contributed to it about 50 papers. He was elected to Congress in 1824, and by successive re-elections held his seat until 1834. Throughout this period he was a member of the committee on foreign relations, and in the 20th Congress its chairman. He drew either the majority or the minority report of many select committees. In politics he was a National Republican (Whig). He declined a renomination to Congress in 1834. In 1835 he was elected governor of Massachusetts, subsequently was three times re-elected, holding the office for four years, and in 1839 was defeated by a majority of one vote. While in Europe in 1840 he was appointed minister plenipotentiary to England. At a time when there were many points of controversy between England and the United States he was successful in the adjustment of numerous important questions. He declined in 1843 an appointment as commissioner to China, and in 1845 was recalled. In 1846–9 he was president of Harvard, and in 1852 he became secretary of state in Fillmore's cabinet for the last four months of the latter's administration. During this brief term of office he settled several difficult matters. In a diplomatic note he declined the joint proposition of Great Britain and France that the United States should enter a tripartite convention which should guarantee to Spain exclusive possession of Cuba in perpetuity. Before he left the department of state he was elected to the Senate. There he vigorously opposed the Kansas-Nebraska bill for the repeal of the Missouri Compromise. He resigned his seat in May 1854. From 1856 to 1859 he pronounced his well-known lecture on Washington in all on 122 occasions, realizing thereby nearly $60,000, which he turned into the treasury of the Mount Vernon Association for the purchase of Mount Vernon by private subscription. He prepared a collective edition of the orations and speeches of Daniel Webster, with an introductory biographical notice; wrote a life of General Stark for Sparks' 'American Biography'; and prepared for the 'Encyclopædia Britannica,' at the instance of Macaulay, a life of Washington afterwards separately published (1860). In 1860 he reluctantly became a candidate for the Vice-Presidency on the Constitutional-Union, or, as it was sometimes known, the Bell-Everett ticket,— John Bell (q.v.) being the Presidential candidate. The ticket received 39 electoral votes,— those of Kentucky, Tennessee and Virginia. During the Civil War he was a staunch Unionist, but disposed also toward a policy of reconciliation. He delivered the address at the dedication of the national cemetery at Gettysburg, Pa., 19 Nov. 1863, and in the Presidential election of 1864 as an elector-at-large he cast his ballot for Lincoln and Johnson.

His last public appearance was at his Faneuil Hall oration, 9 Jan. 1865, on behalf of the sufferers at Savannah.

Everett was noteworthy in his versatility,— a preacher and theologian, a Greek scholar, an editor and author, orator, diplomat, and statesman. He attracted much attention by his pulpit eloquence. As a Grecian he was thoroughly equipped and gave in his time a considerable stimulus in America to the study of Greek letters, antiquities, and history. His literary productions were carefully wrought and marked by his scholarship; but, through interruptions by other activities, they were limited, so far as published, chiefly to his 'North American' articles and the above-mentioned 'Defence of Christianity.' He did not complete a treatise on public law — a subject he was eminently fitted to expound,— on which he was for some time at work. His utterances in Congress showed him rather the orator than the debater, and while a member of the lower house he stood apart from much of party contention as it there appeared. He took, however, a prominent part in discussion, and, as indicated above, was a most valuable committee member. While he was a foreign minister the general negotiations regarding the northeastern boundary and Oregon difficulties were transferred from him through the appointment by Great Britain of Ashburton as special ambassador, yet many of the points in dispute were left to Everett's skilful adjustment. As representative, secretary, and senator he held to the possibility of saving the Union by compromise on the slavery question, but, the war once begun, he was among the ablest supporters and advisers of the Federal government. It is as an orator that Everett is best known. His addresses were generally written with elaborate care, and were of the Ciceronian type in the knowledge and culture displayed as well as in their finished rhetoric. More fully than any other American orator he combined the resources of learning with the arts of the speaker. He lacked Webster's fire and Phillips' magic, but his manner was always impressive and symmetrical. Even in his own time, however, his oratory did not escape criticism for lack of directness and artificiality, and this charge has frequently been made against it. He may be called the pioneer in the American «lyceum,» which long had such a reputation. His 'Orations and Speeches on Various Occasions' were collected in four volumes in 1853–68. Consult also Dana, 'An Address upon the Life and Services of Edward Everett' (1865); 'A Memoir of Edward Everett' (1865); and Whipple's remarks in 'Character and Characteristic Men,' pp. 243–52 (1866).

Everett, Joseph David, English physicist: b. Rushmere, near Ipswich, 11 Sept. 1831. He was educated at Glasgow University; was professor of mathematics King's College, Nova Scotia, 1859–64; assistant in mathematics Glasgow University 1864–7; and professor of natural philosophy in Queen's College, Belfast, Ireland, 1867–97. His scientific career has been a most distinguished one. He took a leading part in the selection and naming of dynamical and electrical units, and drafted a report (1873), the adoption of which originated the C. G. S. system now generally employed. The names «dyne,» «erg,» and « C. G. S. unit» were introduced at his suggestion. His 'Universal Proportion Table,' published in the 'Philosophical Magazine' (1866), was the first application of the parallel column arrangement for obtaining a slide-rule with very open scale. His English version of M. Privat-Deschanel's 'Traité Elementaire de Physique' (1870–2) was so largely re-written as to be almost an original work. Other of his publications are: 'Centimètre-Gramme-Second System of Units' (1875); 'Elementary Text-Book of Physics' (1877); 'Shorthand for General Use' (1877); 'Vibratory Motion and Sound' (1882); etc.

Ev'erett, William, American educator, youngest son of Edward Everett (q.v.): b. Watertown, Mass., 10 Oct. 1839; d. Quincy, Mass., 15 Feb. 1910. From 1870 to 1877 he was assistant professor of Latin at Harvard. He was master of Adams Academy at Quincy, Mass., 1877–93 and in 1897, and was member of Congress 1893–5. He was the author of 'On the Cam' (1865); 'Changing Base' (1868), 'Double Play' (1870), two books for boys; a poem, 'Hesione, or Europe Unchained' (1869); 'School Sermons' (1881); 'Thine, Not Mine'; and many pamphlets on political, literary, and religious subjects.

Everett, Mass., city in Middlesex County, three miles north of Boston; on the Boston & Maine Railway, and with connection by electric surface lines with Lynn, Salem, Chelsea, Boston, and adjacent towns.

Industries, etc.—According to the report of the 13th United States census there were in Everett 62 establishments, with a capital of $22,905,000, employing 2,680 wage-earners at wages amounting to $1,979,000, and having a product valued at $8,747,000. The most important manufactories are a chemical plant, structural iron foundries, steel works, and gas and coke works.

Institutions, Buildings, etc.— There are two public libraries, the Shute Memorial and the Parlin Memorial, and the Whidden Memorial Hospital is also located here.

History, Government, etc.— Everett was settled in 1643, and until 1870 it was a part of Malden. It received its city charter in 1892. Its chief development was in the decade 1890–1900. The government is administered by a mayor, chosen annually, and a municipal council in which members of the lower chamber are elected by wards for one year, those of the upper chamber at large for two years. The more important of the subordinate officials are nominated by the mayor and confirmed by the council; the others are chosen by the council. Pop. (1910) 33,484.

Everett, Wash., city, county-seat of Snohomish County; on Puget Sound; on the Northern P., the Great N., the Everett & M. C. R.R.'s; about 55 miles east by north of Tacoma, and 30 miles north of Seattle. It has an excellent harbor with water communication with the Pacific, and agricultural lands, forests, and valuable mines nearby. Such a combination of natural resources is not common. Everett is the entrepôt of the towns and camps in a rich mining belt. Within a district 36 miles long and 20 miles wide, the Monte Cristo, Great Lake, Silver Creek, Troublesome, Sultan, Stillaguamish, and North Fork district send ores to the great smelter in Everett, and in various ways contribute naturally to the substantial growth of the city. The smelter and refinery plant obtains mineral from all over the Northwest. The city contains railroad shops, flour- and lumber-mills, factories, well-built brick buildings, churches, a theatre, a hospital, graded streets, electric light and motive power, sewers, schoolhouses, newspapers, etc. Its school system is excellent. Everett was settled in 1891, incorporated in 1893. Pop. (1910) 24,814.

Everett-Green, Evelyn, English writer: b. London 17 Nov. 1856. She is the daughter of Mary Wood Everett-Green (q.v.). She was educated at Bedford College, London; studied music at the London Academy; and for two years was a nurse in a London hospital. Since 1883 she has devoted herself entirely to writing. Among her many published works the best known are: 'The Last of the Dacres' (1886); 'St. Wynfriths' (1893); 'Dare Lorimer's Heritage' (1892); 'Dominique's Vengeance'; 'Shut In' (1894); 'Over the Sea Wall' (1894); 'Arnold Inglehurst the Preacher' (1895); 'Squib: His Friends' (1896); 'French and English' (1898); 'Odeyne's Marriage' (1899); 'The Heir of Haskett Hall' (1899); 'Monica' (1900); 'After Worcester' (1901); 'For the Faith' (1901); 'Olivia's Experiment' (1901); 'In Fair Granada' (1901); 'Fallen Fortunes' (1902); 'Alwyn Ravendale' (1902); 'Hero of the Highlands' (1903).

Everett-Green, Mary Anne (Wood), English author: b. Sheffield 1818; d. London 1 Nov. 1895. She moved to London in 1841 and for nearly 40 years was employed in the record office as one of the editors of the 'Rolls Series of State Paper Calendars.' The works edited by her include: 'Letters of Royal and Illustrious Ladies of Great Britain' (1846); 'Diary of John Rous' (1856); 'Letters of Henrietta Maria' (1857); 'Life of William Whitingham' (1870). Her only original work was the 'Lives of the Princesses of England from the Norman Conquest' (1850–5).

Everglades. The name given to a vast tract of land and water in the southernmost part of Florida, a region, though under the very eyes of the early pioneers and bordered by our own advanced lines of commerce and travel, as yet practically undiscovered. It is not a marsh, a swamp, nor a stagnant pool; neither land nor water. No white man has yet penetrated it for any great distance, either by boat or on foot, owing to the variance in the depths of the water and the dense tangle of saw-grass, scrub-willow and custard-apple which abound there. The State of Florida is one immense mountain top of limestone formation, covered with a network of pot-holes, varying in size from a few feet to thousands of acres; it has countless lakes of fresh water, fed by springs and subterranean streams, and among these is Lake Okeechobee, named by the Indians, Lake Mayaimi, and now known as the Everglades, an irregular body of water 130 miles north and south, and 70 miles east and west, the altitude of its rim being 12 feet above mean low tide in Biscayne Bay and a little less above the Gulf of Mexico. Over the rocky bottom of this lake lies a layer of muck, formed of alluvial deposit and decayed vegetation, varying in thickness from a few inches to several feet, and in this muck the saw-grass finds its origin, takes root and sometimes grows to a height of 10 feet. This saw-grass is one of the most peculiar and interesting features of the Everglades. Shooting up rapidly, pale green in color, as it goes through the water, fading in the sunlight to a dull golden tint, its blades are tough as bamboo, its edges sharp and jagged as a saw. Toward the western end of the lake it is interwoven with wild myrtle and forms an almost impassable barrier, running through the entire length of the lake, although there are some passages through it, known familiarly to the Seminole, but which are almost impossible to locate by the explorer.

Scattered along the eastern and western edges of the lake are numerous islands, some very small, others hundreds of acres in extent, covered with luxuriant growths of live oaks and bays, interspersed with wild cucumber, lemon, and orange trees. The papaya, the custard-apple, and prickly-ash are of frequent occurrence, and here and there may be seen the cabbage palmetto, the pine, and the rubber-tree.

The first white man to enter this mysterious, silent country was a Spaniard, one Escalente de Fontenada, who, after being shipwrecked in the Strait of Florida, was made captive and slave by the great cacique, Calos, but he has left us only a few meagre details of his experiences during his 17 years of captivity. Frequent expeditions of exploration have been sent out by the United States government to penetrate this wilderness if possible, but all have failed, each bringing the explorers, after days of hardships and privations, to the conclusion that the Everglades, though fascinating in its wildness, is a region to be avoided; a forest of trees, rank undergrowths, and saw-grass, impenetrable and practically valueless; and the lake a mixture of currents which seem to begin without reason, lead nowhere in particular, and generally end in a comparatively still pool, with a labyrinth of passages from which there seems no direct egress.

Animal life in the Everglades is fairly abundant, deer being found on both eastern and western shores, otter are plentiful, alligators and crocodile quite numerous, while the snake is there in large numbers. The Glades were once the breeding place for the egret, the ibis, and the heron, and, while many of them are yet to be found, the plume hunter has made such inroads that all are nearly extinct. The region is almost free of all insects, the constantly moving water affording no breeding-place for insect life. Small flies and gnats are found where the foliage is thick, as in all regions, and at certain seasons of the year the Everglade waters contain an annoying bug called the "alligator flea." Fish abound in the fresh waters, and the terrapin and a flat, soft-shell turtle are quite plentiful.

Probably the most interesting of the denizens of the Everglades are the Seminole Indians, divided into two clans or families, the Muskokis and the Mikasukes, who for hundreds of years have inhabited this section of Florida, defying all attempts to dispossess them, and in 1835, during the Seminole War, killing a large number of troops, under Major Dade, sent against them. A few have been captured and transported, but the majority still live there, having well earned the right to their homes, close to Nature's touch and with that indefinable bond of friendship which gives them access to her solitudes, knowing little of the white man's civilization and caring less. The shores of the streams by which the Glades are entered are covered with the cocoa-plum tree, which also grows about the edge of the Glades, producing a blue fruit on the eastern and a white fruit on the western edge. Wherever the land is sufficiently dry, the coontie-plant, really the Florida arrow-root, grows, and from these the Indian gets his sustenance, extracting flour and starch from the roots.

The physical features of the Everglades are beyond description, beauty and charm blending in a strange, sweet sense of mystery. In dry weather, when the water is low, it is possible to drive into the Glades, but the most beautiful and ideal approach is by water, all the rivers of the Glades finding their way to the sea, some by the rocky channels worn by their own age-long floods, and some through miles of wandering curves, their shores lined with forests of mangrove trees.

Looking into these forests, only the dark waters are to be seen. Ascending, the fresh water of the Glades overcomes the brackish tidal water, and the cocoa-plum takes the place of the mangrove. Still farther up the river, the cocoa-plum gives way to the cypress, and pond lilies are seen, the whole panorama of shifting green,— the lemon-like foliage of the cocoa-plum, the dark olive of the mangrove, and the lighter green of the cypress, enlivened by the sunlight,— making a scene of unique beauty.

In the perspective, when the water is low, the Glades, with its numerous islands and with the tall golden grass, gleaming in the sunshine, waving over a field of silver, ending with a sky-line of blue, has a charm for the eye, unequaled, perhaps, by any other spot in the world, and gives to the sightseer or explorer that subtle impulse and uncontrollable desire to adventure into this never-ending plain of grass and water, never reaching the goal but always seeking for something that lies just beyond the horizon.

The climate of the Everglades is faultless, showing no extremes of heat or cold, nor is it subject to sudden change. There are two seasons in the year, the rainy and dry, the latter including June and September, although light showers may be expected at any season, and in the autumn the humidity is very high. Malaria is seldom heard of, the pure air giving the best assurance of health, and it is small wonder that the ancient explorers spent years here trying to find the «Fountain of Youth.»

The title to the Everglades is vested in the trustees of the Internal Improvement Fund of Florida, under patents from the Department of the Interior of the United States, by virtue of an act of Congress of 1850, and they are making efforts to drain the Glades and open it to actual settlers, the cost of reclamation being small compared to the great agricultural value, for once dried it would open up the best sugar lands in the South.

Ev'ergreen, Ala., town, county-seat of Conecuh County; on the Louisville & N. R.R.; about 100 miles northeast of Mobile. An agricultural school and experiment station, and the State Baptist Orphan Asylum are located here. Its mineral springs and agreeable climate make it a winter resort. Pop. (1910) 1,582.

Evergreen Isle, a poetical name given to Ireland.

Ev'ergreens, plants that retain their leaves in full verdure throughout the winter till the ensuing spring, when they ultimately fall. It was at one time a common error to suppose that evergreens never part with their leaves. The cause of the belief was that the old leaves do not fall until the young leaves have begun to appear, so that trees of this sort are never wholly without leaves. In warm climates many plants retain their leaves for several years, but no such plants are to be found native to temperate and polar climates. Among the best-known evergreens are most of the trees belonging to the order of the *Coniferæ,* the holly and ivy, box, privet, rhododendron, myrtle, etc.

Ev'erhart, Benjamin Matlack, American botanist: b. West Chester, Pa., 24 April 1818; d. 22 Sept. 1904. After a successful business career in his native town and Charleston, S. C., he retired in 1867, and devoted himself to botanical study, becoming a recognized authority on cryptogamic botany. With J. B. Ellis, of New Jersey, he published in 50 parts a notable work entitled 'The Century of North American Fungi,' describing 5,000 species, many of which were discovered by Everhart. With W. A. Kellerman, professor of botany in Ohio State University, he founded and edited 'The Journal of Mycology,' to which he contributed numerous articles on his specialty. Several new fungi discovered by him have been named after him by his fellow-scientists.

Everlas'ting Flowers, a name applied to certain plants belonging to the natural order *Compositæ,* from the fact that when dried they suffer little change in their appearance. By the French they are called ***immortelles,*** and this name has been introduced into our own language as applied to wreaths made of such flowers to be placed beside recent graves as emblems of immortality. The plants to which this name is peculiarly applied belong to the genus *Helichrysum,* and are natives of Cape Colony and Australia; but it is also given in America to members of allied genera, such as ***Antennaria,*** *Gnaphalium, Anapalis,* etc. The native women of Australia are fond of decorating their hair with the flowers of ***Helichrysum elatum*** and *Helichrysum bracteatum.* See AMARANTHUS.

Everlasting Pea, a popular name for plants of the genus *Lathyrus,* of the pea family. In the United States it is applied to the beach pea (*L. maritimus*), because it often blossoms until late in the fall. In England the everlasting pea is *L. latifolis,* a cultivated plant like the sweet pea.

Everts, Orpheus, American physician: b. 18 Dec. 1826. Since 1880 he has been superintendent of the Cincinnati Sanitarium. He has published 'Giles & Co., or Views and Interviews Concerning Civilization' (1878); 'What Shall We Do for the Drunkard' (1882); 'Facts and Fancies' (1896); 'The Cliffords, or Almost Persuaded' (1898).

Evesham, ēvz'ham or ēvz'am, England, a municipal borough and market town in the county of Worcester; on the Avon; 15 miles southeast of Worcester, beautifully situated in the vale of Evesham. It is an ancient place, and was the scene of a battle fought in 1265, which replaced Henry III. on the throne. It had a celebrated abbey, of which a fine tower and some other structures still remain. Market gardening is the chief industry. Pop. (1901) 7,101.

Eviction. See EJECTMENT AND EVICTION.

Evidence. "The word evidence considered in relation to law includes all the legal means which tend to prove or disprove any matter of fact the truth of which is submitted to judicial investigation." (Taylor.) Evidence may be either oral or documentary. Oral evidence is the statements made by witnesses during the trial; and documentary evidence consists of the production of papers, on which is writing, marks, or characters capable of being read, which are submitted during the course of the trial. Oral evidence must in all cases be direct: if it is of something that was seen, by the person who saw it; if of something heard, by the person who heard it; if of an opinion, by the person who holds that opinion; or if the knowledge was acquired in any other manner, by the person who perceived it in that manner. The general rule is that hearsay evidence is not admissible. Documentary evidence may be either primary or secondary. Primary evidence of a document is where the document itself is produced for the inspection of the court. When a document has been executed in counterparts, each counterpart is primary evidence against the party executing it; and where a document has been made by printing or any other means that will ensure an exact reproduction, each copy is primary evidence of the other copies, but none of them is primary evidence of the original. Secondary evidence of a document would be counterparts of the document as against the party who did not execute them, copies made from the original and compared with it, office copies, official copies, and oral evidence of the contents of a document by a person who has een the original. Before secondary evidence will be received the party offering it must show a legal reason why the original is not produced, such as being lost, destroyed, in possession of the adverse party, who refuses to produce it after notice to do so, or when it is a public document, or when it is in a country or place from which it is not permitted to be removed.

Either oral or documentary evidence may be given of any fact in issue or relevant to the issue; and where two facts are so connected, although one fact is and the other fact is not the issue or relevant to the issue, yet evidence of both may be given if that fact will render probable the existence or non-existence of the other fact which is in issue or relevant to the issue.

Admissions are statements made by a party to any proceeding and in reference to that proceeding, and they are admissible against the party making them, but not in his favor. Admissions may also be made by an agent, but to bind the principal they must be made by the agent in his regular course of business or employment. If an admission is made after an agreement has been entered into between the parties not to use it as evidence, it is not admissible, nor is it admissible in evidence made under duress. A confession is a statement made by a person charged with a crime stating or suggesting that he committed that crime. If made voluntarily it is admissible as evidence against him, but if made while the person is under any threat or promise which has been given by a person in authority, it is not admissible. Confessions may be made during the course of the trial, but if the question which produced the confession is an improper one, and after the witness had refused to answer it he had been compelled to do so, it is not a voluntary confession and therefore inadmissible. But if he made no objection to answering the question, it is admissible as a voluntary confession. A witness' opinion is received in evidence when it falls under the head of expert testimony; as, when the question is of some science or art, the opinions of persons specially skilled in that art or science are relevant. Any subject on which special study or experience is necessary to the formation of a correct opinion, is a science or art. The most frequent illustrations are medical and hand-writing experts. Before the testimony of a person called as an expert is received, he must satisfy the court as to his ability to form a correct opinion on the particular subject on which he is to testify. The general rule is that evidence as to a person's character is not admissible unless it is the fact in issue, except in criminal cases, but if a person introduce evidence to show good character, the other side may produce witnesses to show the contrary. All facts should be proved by the best or highest evidence. If a fact can be proved by a written instrument, the writing should be produced, and the party alleging a fact must prove it.

Evidences of Christianity, in favor of its divine origin, may be divided broadly into two great classes, namely, external evidences, or the body of historical testimonies to the Christian revelation; and internal evidences, or arguments drawn from the nature of Christianity itself as exhibited in its teachings and effects.

Among the earlier Christian apologists were Justin Martyr, Minucius Felix, Tertullian, Origen, Arnobius, and Augustine. Their work was continued by the schoolmen during the Middle Ages. In the 16th and 17th centuries the influences of the Renaissance and the Reformation gave rise to a spirit of inquiry and criticism which developed English deism as represented by Herbert and Hobbes in the 17th century, and Collins and Bolingbroke in the 18th. The general position of English deism was the acceptance of the belief in the existence of God, and the profession of natural religion along with opposition to the mysteries and special claims of Christianity. It was in confutation of this position that the great English works on the evidences of Christianity of Butler, Berkeley, and Cudworth were written. In France the new spirit of inquiry was represented by Diderot, D'Holbach, and the encyclopedists, who assailed Christianity mainly on the ground that it was founded on imposture and superstition, and maintained by sacerdotal trickery and hypocrisy. No reply of any great value was produced in the French Church, though in the previous age Pascal in his 'Thoughts' had brought together some of the profoundest considerations yet offered in favor of revealed religion. The 19th century was distinguished by the strongly rationalistic spirit of its criticism. The works of such writers as Strauss, Bauer, and Feuerbach, attempting to eliminate the supernatural and the mysterious in the origin of Christianity, were answered by the works of Neander, Ebrard, and Ullmann on the other side. The historical method of investigation, represented alike by the Hegelian school and the Positivists in philosophy, and by the Evolutionists in science, is the basis of the chief attacks of the present time against the supernatural character of Christianity, the tendency of all being to hold that, while Christianity is the highest and most perfect development to which the religious spirit has yet attained, it differs simply in degree of development from any other religion. Notable among later apologists of Christianity have been Paley ('Natural Theology'), Chalmers ('Natural Theology'), Mansel, Liddon, and others, Lecturers of the Bampton Foundation; in Germany, Luthardt, Ewald, Baumstark, and others. Consult: Hopkins, 'Evidences' (1864); and Fisher, 'Grounds of Theistic and Christian Belief' (1883; revised ed. 1902). See CHRISTIANITY; HIGHER CRITICISM.

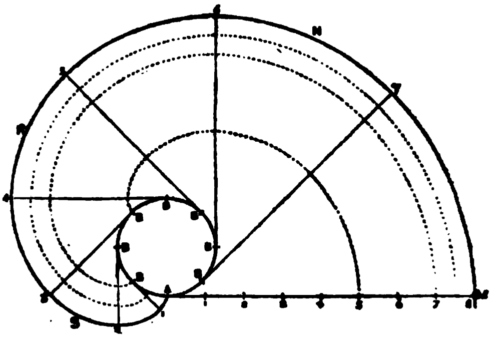
Evil, King's. See SCROFULA.

Evil, Origin of, the subject of extensive theological and philosophical speculation. The difficulty of the question lies mainly in the fact that the existence of evil in the world seems inconsistent with the view that it was created and is maintained by an omnipotent and beneficent creator. The various theories on the subject have all sought to elude this difficulty either by the supposition of some principle of evil equally eternal with that of good, or by regarding evil as having only a relative existence, being a kind of good in an imperfect and immature stage.

Perhaps the oldest theory on this subject is that of Parseeism, or the religion of Zoroaster, according to which there were two original antagonistic principles, one good (Ormazd) and the other evil (Ahriman). This is the doctrine that is now very often spoken of as Manichæism. In contradistinction to this dualistic theory with reference to the origin of evil stand the Monistic theories of Brahmanism and Platonism. According to the Brahmanic doctrine of the emanation of all things from one original being (Brahma), this original being was regarded as the sole true existence, and the phenomenal world, with all the evils appearing in it, was held to be mere illusion. Similarly Plato held that the good was the essence of all things, and that the evil and imperfect contained in them had no real existence. The theory enunciated by Leibnitz in his 'Theodicée' ('Vindication of God') resembles that of Plato. In that work he assigns to the evil existing in the world created by God, which he holds to be the best of all possible worlds, a merely relative existence; all that we call evil is, he holds, only evil to us because we do not see it in relation to the rest of the universe, for in relation to the universe it is not evil but good, and accordingly cannot be evil in its own nature. The traditional Christian account of the origin of evil is that given in Genesis. In the theology based thereon, Satan, the personal principle of evil, differs from the Zoroastrian Ahriman only in not being co-ordinate with the personal principle of good.

Evil Eye. See SUPERSTITION.

Ev'olute, In'volute, in mathematics, correlative terms first applied to the tracing of curves by Huygens, whose discussion of the subject is contained in his 'Horologium Oscillatorium' (1673). Under this distinction every mathematical curve is considered as one of a pair which are mutually produced. This may be explained in the following manner. Around a circular disk wrap closely a thread free at one end and fastened at the other. To the free end attach a lead-pencil. If, now, the string be held taut and unwound from the curve, a second curve will be traced by the pencil. The curve so traced is the involute of the curve whence the string is unwound. The given curve is the evolute of the curve traced. See CURVES.



Circle, BBB, as Evolute and its Spiral Involute, MNRSA

Evolution, in the natural sciences a term used to denote the process by which an established state of affairs, or system of things, or degree of organization, after persisting for a time, gives rise to another. Thus, we speak of the evolution of the solar system, the evolution of continents, the evolution of plants, the evolution of animals, the evolution of man, the evolution of the brain, and so on endlessly. Evolution expresses the same idea as the term development, but it is convenient in biology to restrict the latter to the growth of the individual (ontogeny), and to keep the former for the growth or history of the race (phylogeny). The fundamental idea of evolution is the essentially simple one, that "the present is the child of the past and the parent of the future"; or, from another point of view, that "there is nothing in the end which was not also in the beginning." More concretely, when we say that the living creatures which we see around us have been evolved, we mean that they are descendants of ancestral forms on the whole simpler, and that these ancestors were descended from still simpler forms, and so on backward — till the scientific imagination loses itself in the mist of life's beginnings. The process of change has been on the whole, as the rock records plainly show, toward increased complexity of structure (differentiation) and toward increased unification and harmonious control of life (integration); but there are many cases of degeneration, both among plants and among animals, where the usual direction of evolution has been in a sense reversed, and where degenerate forms having bcome adapted to parasitic or sedentary or easy-going conditions, are in many respects simpler than their ancestors. In its higher reaches, especially in mankind, evolution has been in great part a progress in psychical integration; but the general idea is the same whether we are dealing with the increasing complication of skeletal architecture in sponges or with the increasing complication of cerebral convolutions in mammals.

Historical.— The evolution idea seems to have been recognized first in relation to human history; thence it was projected upon inanimate and animate nature. One form of institution grows out of another, one race out of another, one language out of another; thus the question arose whether the same may not be true of the order of nature as a whole. Laplace applied the idea in astronomy, and in his famous nebular hypothesis sought tò show how the solar system may have been evolved from a simpler antecedent state of affairs. Similarly, Lyell was the most prominent among those who showed that in regard to the configuration of the earth the evolution formula is vividly descriptive. From inanimate nature and human affairs the fertile idea spread like a leaven to the study of fauna and flora and man himself. What Lucretius and much earlier thinkers had dreamed of, what Leibnitz and Schelling and Kant and other philosophers with strong interests in the outer world had sketched in general terms, what Buffon, Erasmus Darwin, Lamarck, Treviranus, Etienne Geoffroy St. Hilaire, Goethe, and others had ventured to promulgate, became through the work of Charles Darwin, Alfred Russel Wallace, Herbert Spencer, and Ernst Haeckel current intellectual coin — the theory of descent. From biology the idea spread to psychology, and the origins of instinctive, intelligent, and rational activities were sought after; finally the idea came home again to its original starting point, as a formula applicable to human history. Already the idea is fast becoming organic in our way of thinking about the origin of all present appearances — whatever be their nature — as a thought economizing formula applicable to all orders of facts.

Analogy of Evolution and Development.— Applied to plants and animals, the suggestion involved in the evolution idea is that the forms now existing are the descendants of relatively simpler ancestors, that they represent, as it were, the tips of many branches which gradually run together as we trace them backward or downward, till they finally unite in a common base — the original forms of life of which nothing is directly known. Moreover, it is implied that the evolution of a race, say of horses or of roses, has been a continuous natural process of slow transformation, just as the individual development of horse or rose-bush is demonstrably a continuous natural process of slow transformation from the apparently simple to the obviously complex. We know as yet but little in regard to the actual factors at work in the marvelous process by which a plant or an animal develops in a few days or weeks or months out of an apparently simple fertilized egg cell; similarly, we know as yet but little in regard to the actual factors which were at work in the marvelous process by which a race of plants or animals, or a particular type, is supposed to have evolved through unthinkably long ages from its apparently simpler presumed ancestors. In neither case has biology advanced far in its analysis of the factors, yet in both cases the majority of biologists would unhesitatingly accept the fact — that a bird grows from an egg by a process of natural development, and that the race of birds has arisen from a reptilian ancestry by a process of natural evolution. But while the development of the bird may be seen taking place, the evolution of the race of birds is hidden in the past; so that we naturally ask for the evidence which has led naturalists to the confident acceptance of the evolution doctrine.

Evidences of Evolution.— The evolution idea has been accepted by naturalists partly because it has proved illuminative in regard to other orders of facts, partly because it has been so useful in promoting and giving point to research, and partly because of certain so-called «evidences» which, though not demonstrative, have nevertheless a cumulative value in establishing a presumption in favor of the interpretation suggested. For it must be clearly recognized that the doctrine of organic evolution does not stand on a secure inductive basis, like for instance the doctrine of the conservation of energy or the theory of gravitation. We are aware of no facts which are contradictory to it, the constant accumulation of new facts brings none to light which it does not fit, but it is a logical error to speak of the doctrine as demonstrated. There is even a slight confusion of thought in speaking of the «evidences of evolution,» since all the known facts of life may be construed as part of the evidence. But as there are certain kinds of facts which suggest the evolution idea more forcibly than do others, the nature of these may be indicated.

(a) It is well known that even within the short period covered by careful observation, the forms of life do not remain constant in their characters. Even among forms that are so essentially like one another that they are called by one name — the name of their species — changes are continually occurring. Some of these changes seem to be definitely related to use or disuse or to some alteration in the external conditions (or environment), and we call these modifications or acquired characters. It is very doubtful whether these are transmissible. But there are other changes which begin to appear before or at birth, and cannot be referred directly to changes in function or environment, but seem plausibly due to changes in the germinal material or hereditary substance before or during or after fertilization, and we call these germinal or congenital variations. There is no doubt that these are in varying degrees transmissible, though they may not always be transmitted. By selecting the possessors of suitable variations and causing them to interbreed, cultivators of plants and breeders of animals have in a short time reared many distinct races, as is well known in the case of cabbages and chrysanthemums, pigeons and rabbits, horses and dogs. If man by slight interference can secure these results in a very short time, the inference is suggested that in the enormous time during which living creatures have existed in the earth, proportionately great changes may have been wrought out.

(b) The immense array of plants and animals — living and extinct — that we know can be classified in orderly series. We see various types of organic architecture, bound together by structural affinities, grading into one another, rising one above the other in more and more elaborate complexity and gradually increasing integration. They can be arranged in a scheme of classification, which though still very imperfect may be expressed in the form of a genealogical tree. The suggestion is, that the affinities and gradations on which the classification is based, have a historical meaning, that they express blood relationships, that they point to a descent from common ancestors. Moreover, in a large number of cases the boundaries between what are called distinct species are seen on closer examination to be much less definite and discontinuous than they at first sight appear to be. Species is linked to species by intermediate varieties; genus is linked to genus, and family to family; nor are there wanting synthetic types or «missing links» which help us in imagination to bridge the gulf between distinct types, for example, *Peripatus* between annelid worms and insects, or *Balanoglossus* between some worm-like stock and vertebrates. Remarkable also is the manner in which in distinct groups the same organic material is turned and twisted to diverse results; how, for instance, essentially the same structure of muscle and bone, nerve and blood vessels, is used in vertebrate animals to form the frog's anterior limb, the bird's wing, the horse's fore leg, the whale's flipper, the man's arm, and so on. These homologies or essential similarities in structure and development seem to be most readily interpreted as expressions of a natural descent from common ancestors. Another notable fact is the frequent occurrence of vestigial structures, such as the rudimentary hind limbs of whales, the rudimentary two sets of teeth in the whalebone whales, the visceral clefts in reptiles, birds, and mammals, which are certainly homologous with gill clefts though all possibility of branchial respiration has disappeared. They are only of indirect use, and yet they persist, like, as Darwin said, the unsounded letters in certain words — practically of no direct use — yet giving (here the interpretation comes in) a hint as to the ancestry of the forms which possess them. They are relics of the past, and man himself in this regard carries about with him in his body a museum of antiquities.

(c) Alike in the history of a race as revealed in the geological record, and in the development of the individual organism, which is the problem of embryology, we find numerous facts which suggest, though they do not demonstrate, that the evolution conception is an adequate modal interpretation of the world of life. Thus we have the broad fact that in the history of the earth fishes preceded amphibians; amphibians preceded reptiles, reptiles preceded birds; and many other illustrations show that lower races appeared on the scene before higher ones. It is also possible to work out what are called «palæontological series,» in which there is a structural progress in certain stocks, families, or genera, as we pass from later to more recent formations: for example, the series of horse-like mammals, of crocodilian reptiles, of nautiloid cephalopods, of ammonites, and so on through a long list. And again, the rock record discloses extinct types which bridge some of the structural gaps between the living races; thus, *Archæopteryx,* the oldest known bird, helps to link the modern birds to their presumed reptilian ancestry, and the extinct eurypterids lessen the apparent gap which separates the king-crab (*Limulus*) from other jointed-footed or arthropod animals. Not less suggestive is the study of individual development, showing a strikingly gradual progress from the apparently simple to the obviously complex, and an undeniable parallelism between stages in individual growth and grades of organization expressed in the adults of lower forms. It is more rhetorical than scientific to say that an animal in its individual development «climbs up its own genealogical tree,» especially since the construction of that hypothetical genealogical tree depends partly on the data furnished by the study of development; but even a brief study of the fortunately preserved stages in the individual growth of fossil cephalopods, or of the familiar circuitous life history of the common frog, shows a parallelism between individual development and racial history which is strongly suggestive of the evolution idea. At the same time, it must be re-emphasized that conviction as to the value of the evolution theory is to be attained, not by a laborious induction, but by its practical justification of itself as a working formula in the study of all orders of facts.

Factors in Organic Evolution.— By the cumulative force of the presumptive evidence we may become convinced that the race of birds evolved from a more ancient reptilian stock, and that the thousands of different kinds of living forms have evolved from a few primitive types, of which we get some hint in *Archæopteryx,* the oldest of the extinct birds. It is quite another matter, however, to profess to understand the precise steps and factors in the process by which «the slow, cold-blooded, scaly beast ever became transformed into the quick, hot-blooded, feathered bird, the joy of creation.» The only possible method is to discover the factors which are at present at work in nature, to combine these in a consistent theory, and to test this by applying it to the concrete facts. As it is quite likely that we have not as yet detected all the factors at present operative in producing organic change, and still more likely that we have not succeeded in rightly estimating the relative value of these factors, no completeness can be claimed for the theory of organic evolution in any of its forms. It is also evident that the process of verification which must succeed the process of interpretation will necessarily demand prolonged observation and experiment. The logical possibilities deduced from a study of particular cases, must be shown to be real possibilities for each particular case. Already, however, considerable progress has been made in this respect, and a more stable evolution theory is being gradually evolved.

Originative Factors.— When we compare children with parents, brother with brother, neighbor with neighbor, native with foreigner, but always keeping within the limits of what is called a species, such as the domestic sparrow (*Passer domesticus*), or the edible snail (*Helix pomatia*), or the buttercup (*Ranunculus Ficaria*), we find that the individuals are not by any means always alike in all their characters. We can measure many of the observed differences, and make curves expressing the results. There is no fact more certain than that changes in the structure of plants and animals do occur from generation to generation, and it is in such changes that we must find the raw material of evolution. When the observed differences are studied more carefully, it becomes apparent that a number of them may be directly connected with changes or differences in the surrounding influences or environment, or with changes in the activity or functions of the organism. It is characteristic of these changes that they do not appear till some particular change or difference in the environment or function occurs, and that they are usually exhibited in some measure by all the members of the species who may be subjected to the given environment, or who may exhibit the given change of function. In other words, they can be induced experimentally. It is convenient, as we have already noted, to call these changes «modifications,» but they are often referred to under the title «acquired characters.» A «modification» is a change in bodily structure which transcends the limits of organic elasticity, which has, that is to say, some persistence, which may, moreover, be correlated with definite changes in environment or in function. To take simple examples; the sun-burning of the skin in a tropical country; the changes in a plant's leaves and flowers when it is transplanted to a quite different habitat; the alterations of even skeletal structure which follow a peculiar occupation or function, like shoemaking; the change of color in a canary's plumage after a special diet; the dwarfing of water snails which are reared in confined space where they have insufficient exercise, etc.; the changes in a brine shrimp's tail induced by altering the salinity of the water, these are all «modifications»— bodily changes which have some measure of persistence. Such «modifications» are often of considerable value to the individuals who acquire them, as may be illustrated by unusual hardening of the skin on positions, like the sole of the foot, which are subjected to unusual influences of pressure, etc., in people who go barefoot. Many naturalists regard these bodily modifications as forming part of the raw material of evolution; but this cannot be the case unless modifications are as such in some degree transmissible to the offspring, and this has not as yet been proved experimentally. Unless the bodily modifications have a specific and representative effect on the germ cells, such that these, when they develop into offspring, will reproduce the modification in some measure, then these modifications, however important in the individual life, are not of direct importance in the racial evolution. It is much too soon to venture on any dogmatic statement on the subject, but as yet no secure evidence of the transmission of acquired characters has been furnished.

Now, when we consider the sum of observed differences, and the sum of what may be proved to be, or may be plausibly regarded as «modifications,» we find that the latter do not nearly equal the former. It is necessary, therefore, to seek for some other source of the observed differences, and it is customary to call the residual differences (which remain after subtracting the modifications from the observed differences) by the technical name of «variations,» the term being often qualified by such adjectives as «spontaneous,» «congenital,» «constitutional,» «germinal» — all of which refer to the fact that we cannot relate them to differences or changes in environment or in function. These «variations» may appear very early, even before birth; they are exhibited unequally by the members of the species; they are certainly transmissible, though not always transmitted; they are such as may be fairly regarded as forming the raw materials of possible evolution. As to their causes, it is almost premature to speak, but there are several obvious possibilities, none of which is without some basis of fact. Thus (a) the variations may be due to the readjustment brought about in the mingling of hereditary qualities which occurs in the fertilization of the egg cell by the spermatozoon; or (b) they may be due to the influences on the complex germinal material exerted by the variable nutritive conditions within the body, or by the variable environment external to the body. There is no doubt that many diseased conditions have their beginning in a more or less mysterious germinal source; they cannot be ascribed to the direct action of environment or of function on the body; they are congenital, constitutional, innate changes. In some cases, where the rock record is very complete, it is possible to study the variations which occurred in the distant past. Thus, in ammonites and nautiloids, or in gasteropods like *Paludina* and *Planorbis*, the variations which lead on from one species to another have been studied with much success. In most cases, however, the rock record is much too imperfect to admit of this, and it thus becomes of fundamental importance to discover as much as possible in regard to the variations occurring in nature at the present time. For it is only when we have certain knowledge that such and such variations do actually occur now, that we are justified in supposing that similar variations may have occurred in the past. With this study of variation, especially by the use of statistical methods, considerable progress has been made. Thus we know that variations are continually occurring, and that some forms are more variable than others; that the variations can in many cases be registered on symmetrical curves, so that the use of the word «chance,» except in its mathematical sense, is inappropriate; that it is common for an organism to vary, not in one particular feature by itself, but in many characters at once, as if it changed as a whole and not piecemeal; that some variations are merely what may be interpreted as due to an incompleteness in the expression of the normal inheritance, while others are new departures; that some variations are very minute, the variant differing from its parent just as one stage of individual growth differs from its antecedent; that other variations imply changes of considerable magnitude, new structural arrangements appearing suddenly and with some measure of completeness, so that they may be said to be «discontinuous» or «transilient,» that some variations are disadvantageous and lead on to disease, while others seem from the first useful and adaptive to the conditions of life.

Directive Factors.— As we have seen, the raw material of progress is found in the continual crop of variations, and, according to some, in the continual occurrence of modifications. But as it is not certain that modifications are transmissible, they must at present be left out of the evolution scheme. It has been pointed out, however, that useful modifications may be of indirect importance in evolution by favoring the survival of those organisms which are plastic enough to acquire them till coincident congenital variations in the same direction may have had time to acquire strength and persistence. The adaptive modification acquired by each successive generation afresh, may act as «a screen to perpetuate and develop congenital variations and correlated groups of these.» But this requires to be substantiated by concrete instances. Similarly, we require a period of precise observation before we can form a secure judgment in regard to the scope and adequacy of the directive factors of evolution, which are summed up in the terms «natural selection» or «elimination,» and «isolation.» At present our view must depend on our conclusions as to three debatable subjects: (1) The transmission of modifications or acquired characters; (2) the nature of variations and the proportion of these which are non-adaptive; and (3) the extent to which discriminative elimination occurs in the struggle for existence.

Natural Selection.— The «struggle for existence» is a convenient formula for a certain aspect of animate nature. Most living creatures have a tendency to rapid increase; the results of this often come into conflict with the increase of their means of subsistence, or even with the limitations of space; a further result is the elimination of the many and the survival of the few. In other words, many members of a species have a shorter life, and leave fewer or less successful offspring, than others. The so-called «struggle» — a term which must not be taken too literally — may begin before birth; for example, between the numerous possible egg cells among which only a few may survive, or between the numerous spermatozoa, only a small percentage of which may survive in successful fertilization. And the struggle may, as Darwin said, continue on to the hour of death. There is a second fundamental reason for the struggle, namely, the variability of the physical environment — climate, weather, temperature, illumination, pressure, etc.— to which organisms are at the best only relatively well adapted. On these primary conditions of struggle others depend; for example, that one kind of organism naturally feeds on another, or that there may be a disproportion between the numbers of the sexes, so that all cannot be mated. The struggle may be between the living creature and inanimate nature, between plants and animals, between one race of animals and another, between members of the same species, between rival males, . . . and so on till we come down to the germ cells. The objects, too, are as diverse as the possible parties; they include especially (1) individual existence and well-being; and (2) the continuance of family and kin — both of them objects of great complexity. The degrees of intensity are not less diverse — from life-and-death struggle for bare subsistence to a rivalry in the pursuit of increased pleasure; but the intensity will mainly depend on the rate of reproduction and the variability of the environment. In short, the struggle for existence is a function of numerous, partly dependent, partly independent variables. It is a general technical expression of what occurs whenever the effectiveness of an organic response is of critical moment in relation to continuance and well-being.

The fact of elimination is obvious, the difficulty is to decide how far it is discriminative. The occurrence of a storm may thin the ranks of an overcrowded community, but it cannot be assumed that the survivors do survive in virtue of the possession of particular characters. This has to be proved by careful comparison of the survivors and the eliminated, and it cannot be said that this has yet been done in a sufficient number of cases to give us the security we should wish to have in speaking of discriminate elimination or selection. The task is the more difficult since elimination does not necessarily mean immediate death, but may only mean a shorter or less vigorous life and fewer and less vigorous offspring. It is evident that when the farmer thins the turnip crop with rapid strokes of the hoe, he is for the most part an indiscriminating eliminator, though he may now and again pause to spare a particularly promising plant which happens to catch his eye. The theory of natural selection is based on the assumption (in some cases verified) of discriminate elimination. for the fundamental idea of the theory is that in the struggle for existence those forms are eliminated which are relatively unfit, the survivors being those which are varying in the direction of greater fitness or more perfect adaptation to the particular conditions of their life. It must be borne in mind that by the phrase «survival of the fittest,» evolutionists always mean the survival of the fittest relative to given conditions.

Isolation.— It has often been urged as an objection to the Darwinian theory, that particular variations of small amount would tend to be lost or neutralized by intercrossing. In his artificial selection the breeder takes measures to prevent this by isolation, but what is the factor in natural conditions? In answer to this objection, it has been suggested that numerous similar variations may occur at once, for example, under the influence of a similar environmental stimulus. It may also be answered that the experience of breeders and cultivators shows that variations are by no means always readily swamped, even in the absence of isolation. Some new departures have a remarkable potency for persistence even when the conditions do not appear favorable. It is possible to conceive of a struggle for existence within the fertilized ovum, wherein the physical basis, corresponding, let us say, to a strongly marked paternal variation, asserts its «prepotency,» and expresses itself in development through succeeding generations even without co-operation from a similar characteristic on the maternal side. But the answer which has been emphasized, especially by Romanes and Gulick, is expressed in the word isolation. Under this term is included a variety of ways in which free intercrossing between members of a species is prevented, for example, by geographical barriers, by changes of habit, by reproductive variations causing mutual sterility or incompatibility between two sections of a species living on a common area, and so on. There can be little doubt that isolation in some of its forms has been an important factor in evolution, but there is still lack of sufficiently precise evidence in regard to the supposed swamping without isolation, and in regard to the general prevention of free intercrossing.

Thus, at the present date, we are led to the conclusion that while the general conception of evolution stands more firmly than ever as a reasonable modal interpretation of organic nature, there is great uncertainty in regard to almost every question concerning the factors in the evolution process. It may also be noted in conclusion that the evolutionist's task is altogether a scientific one, and has in itself nothing whatever to do with ultimate problems. The evolutionist interpretation is not in the slightest degree a philosophy of nature, but an attempt to show how the present may be accounted for in terms of the past by the intrinsic factors observed to be at work. Neither in this nor in any of his tasks does the scientific investigator seek after ultimate explanations. At some point or other he assumes to start with an original institution of the order of nature, in other words a creation, and at no point does he imagine that he is doing more than working out a formula to fit facts.

John Fiske.

Evora, ā'voo-rä (ancient Ebora), Portugal, capital of the province of Alemtejo, 72 miles east of Lisbon. It is a very ancient city; Quintus Sertorius took it in 80 B.C., and it was also conquered by the Moors in 715, but recovered from them in 1139. Among the famous Roman antiquities of Evora are the temple of Diana, with fine Corinthian columns; an aqueduct erected by Quintius Sertorius, and restored in the 16th century, which still supplies the city with water; and the beautiful tower, surrounded by Ionic columns, at the extremity of the aqueduct, and which, although it has existed since 70 B.C., is in almost perfect preservation. It has an archiepiscopal library, containing, besides some 25,000 volumes, several pictures of great merit. There are some manufactures of cotton, cloth, and hats, and a trade in wine. Pop. 15,134.

Evremond, āvr-môṅ. See Saint Evremond.

Evreux, ā-vrė (ancient Civitas Eburovicum), France, the capital of the department of Eure; on the Iton; 57 miles west by northwest of Paris. It is one of the oldest towns of France, and its ruins and existing ancient Norman buildings show its antiquity. The most noted of the buildings are the Church of Saint Taurin, the bishop's palace, dating back to 1484; the Tour de l'Horloge, built in the same century, is also one of the prominent features of the town. The educational institutions located there include two theological seminaries, a library, a lycée, and a small museum. The history of the town has been of the same tumultuous order as that of many other towns in that section of France, having been taken from the Romans by Clovis; the Normans under Rollo pillaged the town in 892; Henry I. of England captured it in 1119, laying it in waste by fire; Philip Augustus of France took it in 1194 and in 1199; and during the wars of the 15th century between the French and English it was the scene of many bloody conflicts, being passed from the control of one to the other many times. The principal manufactures are hosiery, leather, tiles, and bricks. Pop. (of the commune) 17,113.

Ewald, Georg Heinrich August, gā-ōrg hĭn'rĭH ow'goost ā'vält, German Orientalist and biblical critic: b. Göttingen 16 Nov. 1803; d. there 4 May 1875. As a student he published his first critical work, ‘Die Composition der Genesis.’ He became professor of theology at Göttingen in 1831, and in 1835 professor of Oriental languages. As one of the seven professors of Göttingen who signed the protest against the abrogation by King Ernest Augustus of the Hanoverian constitution, he lost his position, and accepted, in 1838, a call to Tübingen as professor of philosophy. He returned in 1848 to Göttingen, and resumed his old position. When Hanover was annexed by Prussia in 1866 he became a zealous defender of the rights of the ex-king, and this led to his removal from his university chair, though his salary was continued. He was elected several times a member of the diet, where he spoke strongly in favor of the restoration of the Hanoverian monarchy. His ‘Kritische Grammatik der hebräischen Sprache’ (Critical Grammar of the Hebrew Language) (1827), afterward merged in his ‘Ausführliches Lehrbuch der hebräischen Sprache,’ and continually enlarged (8th edition, 1870), formed an epoch in the study of Hebrew and placed Ewald in the first rank among scholars. ‘Das Hohe Lied Salomos’ (The Song of Solomon); ‘Die poetischen Bucher des Alten Bundes’ (The Poetical Books of the Old Testament); ‘Die Propheten des Alten Bundes,’ containing a translation and interpretation of all the prophets in chronological order; together with his ‘Geschichte des Volks Israel’ (History of the People of Israel); and ‘Die Alterthümer des Volks Israel’ (The Antiquities of the People of Israel), are his principal works on the Old Testament. The ‘History of Israel’ is considered his greatest work, and, like others of his more important writings, has been translated into English. On the New Testament he wrote, among other works: ‘Uebersetzung und Erklärung aller Bücher des Neuen Testaments’ (Translation and Explanation of all the Books of the New Testament). Another important work is ‘Die Lehre der Bibel von Gott, oder Theologie des Alten und Neuen Bundes’ (the Doctrine of the Bible regarding God, or Theology of the Old and New Testaments). He also wrote philological treatises on various eastern languages, and on subjects connected with them, among which may be mentioned works on the Book of Enoch, on Phœnician inscriptions, on Phœnician views regarding the creation of the world, on Arabic Grammar, and ‘Linguistic Studies.’ From 1849–65 he issued a serial almost entirely written by himself called ‘Die Jahrbücher der biblischen Wissenschaft’ (Year Books of Biblical Science).

Ewald, ä'väld, **Herman Frederik,** Danish novelist: b. Copenhagen 13 Dec. 1821. The most noteworthy of his novels are: ‘Valdemar Krone: Story of His Youth’ (1860); ‘The Nordby Family’ (1862); ‘Johannes Falk’ (1865); ‘Charles Lyng,’ a fine character study. He also wrote several historical novels popular both in the original and in German translations: ‘The Swedes at Kronborg’ (1867); ‘Agathe’ (1873); ‘Knud Gyldenstjerne’ (1875); ‘Anna Hardenberg’ (1880); ‘The Queen's Maidens’ (1885); ‘Griffenfeld’ (1888); ‘Clara Bille’ (1892).

Ewald, or **Evald, Johannes,** yō-hän'nĕs, Danish poet: b. Copenhagen 18 Nov. 1743; d. there 17 March 1781. At 15 he ran away and enlisted in the Prussian service. Being compelled to join a regiment of artillery at Magdeburg, instead of being attached to the hussars as he had been promised, he deserted the Prussian standard in the Seven Years' war, and entered the Austrian service. After a few months he returned home and began to apply himself seriously to theology. On the death of Frederick V. of Denmark he was requested to compose an elegy (1766); and the general admiration with which it was received roused his ambition and he soon became one of the most eminent lyric and tragic poets of his nation. His opera the 'Death of Balder' (1774), the subject of which is taken from the northern mythology, and his 'Rolf Krage' (1770), a tragedy taken from the ancient history of Denmark, are works which, notwithstanding many defects, bear the impress of true genius; but by some his lyrical drama 'The Fishers' (1779) is ranked as the finest of all his works. As a lyric poet he is most popular at the present day, and several of his odes and elegies are among the best that modern times have produced. Consult Jorgensen, 'Johannes Ewald' (1888).

Ewart, James Cossar, British zoologist: b. Penicuik, near Edinburgh, 26 Nov. 1851. He was educated at Edinburgh University, where he graduated M.D., and was appointed demonstrator of anatomy 1874. In 1875 he became conservator of the museum, University College, London; in 1878 professor of natural history, Aberdeen University; and in 1882 professor of the same, Edinburgh University, when he was also appointed member of the Scottish Fishery Board. In London he made researches into the bacillus of splenic fever, etc., and at Aberdeen founded the first marine laboratory in Britain, where, with the late Dr. Romanes, he made researches into the locomotor system of the echinoderms, which was the subject of the Croonian lecture of the Royal Society 1881. He conducts the fishery investigations into the fertilization and life history of the herring, whitebait, and other food-fishes, and directs a large corps of assistants in the work at various stations. He established lectureships in his university in embryology and the philosophy of natural history, and organized, for the students, a union. At Penicuik he has conducted the costly experiments, with which his name is widely known, into the development of the horse, and hybridizing of equine species, including the quagga, zebra, and island pony, in different ways; and disproved the hoary theory as to the influence of previous impregnation (telegony). Among his publications are: 'The Electric Organs of Skate' (1888–9); 'The Cranial Nerves and Lateral Sense Organs of Elasmobranchs' (1889); 'The Development of the Horse' (1894); 'Telegony and Reversion' (1887); 'A Critical Period in the Development of the Horse' (1889); 'Guide to Hybrids' (1900).

Ewbank, ū'bank, **Thomas,** American scientist: b. England 11 March 1792; d. New York 16 Sept. 1870. He came to America about 1819 and engaged in manufacturing (1820–36). He was United States commissioner of patents 1849–52. His publications include: 'The World a Workshop, or the Physical Relation of Man to the Earth' (1855); 'Life in Brazil,' with an appendix on a collection of American antiquities (1857); 'Reminiscences in the Patent Office' (1859); 'Thoughts on Matter and Force' (1858); and 'Inorganic Forces Ordained to Supersede Human Slavery,' an essay.

Ewell, ū'ĕl, **Alice Maude,** American novelist: b. Prince William County, Va., 7 Nov. 1860. She has published 'A White Guard to Satan,' an historical novel (1900).

Ewell, Benjamin Stoddert, American educator: b. Washington, D. C., 10 June 1810; d. James City, Va., 19 June 1894. He was graduated at West Point 1832, taught mathematics there until 1836, and later served as assistant engineer of the Baltimore & Susquehanna Railroad, becoming professor of mathematics at Hampden-Sidney College 1839, where he remained till 1846. He filled a similar chair at Washington University, Lexington, Va., 1846–8, when he went in the same capacity to William and Mary College, becoming its president 1854, and president emeritus 1888. He was in command of the 32nd Regiment, Virginia Volunteers, from 1861–2, and adjutant-general of the Confederate army on the staff of Gen. Joseph E. Johnston, when he was commander of the departments of Tennessee and Mississippi 1862–4.

Ewell, Marshall Davis, American lawyer: b. Oxford, Mich., 18 Aug. 1844. He was graduated at the University of Michigan Law School (1868), and was professor of common law in the Union College of Law, Chicago, from 1877 until the founding of the Kent College of Law, in which he became professor of international law, dean, and president. He is well known as a microscopist, and was elected a Fellow of the Royal Microscopical Society of London (1886), and president of the American Microscopical Society (1893). He has edited: 'Blackwell on Tax Titles' (1875); 'Illinois Reports' (Vols. XXXII.-XXXVI. inclusive, 1877); 'Washburn's Manual of Criminal Law' (1878); 'Evans on Agency' (1879); 'Lindley on Partnership' (1881); and written: 'Leading Cases in Disabilities' (1876); 'Treatise on the Law of Fixtures' (1877); 'Essentials of the Law' (1882); 'Student's Manual of Medical Jurisprudence' (1887).

Ewell, Richard Stoddert, American soldier: b. Georgetown, D. C., 8 Feb. 1817; d. Springfield, Tenn., 25 Jan. 1872. He was graduated at the United States Military Academy in 1840, and served during the Mexican war with Scott from Vera Cruz to the City of Mexico. At the outbreak of the Civil War he resigned his commission in the National army; joined the Confederates; was actively engaged throughout the war and attained the rank of lieutenant-general. He was at the battles of the first and second Manassas, where he lost a leg, Front Royal, Cross Keys, Port Republic, and Cedar Mountain; and was later placed in command of the Second Corps of Gen. Lee's army, upon the death of "Stonewall" Jackson. In this capacity he was in personal command and led the charges of the corps at the capture of Winchester at Gettysburg, the Wilderness, and Spottsylvania Court House, but was transferred to the Department of Richmond after these engagements, owing to his inability to withstand the hardships of another campaign, on account of his wounds. He was later captured at Sailor's Creek. After the war he retired to private life.

Ewer, ū'ėr, **Ferdinand Cartwright,** American Episcopal clergyman: b. Nantucket, Mass., 22 May 1826; d. Montreal, Canada, 10 Oct. 1883. He was graduated at Harvard 1848. After several years devoted to journalism he entered the Episcopal ministry and became rector of Grace Church, San Francisco, 1858. In 1862 he was chosen rector of Christ Church, New York, but his introduction of ceremonies and practices not usual in Episcopal churches caused so much opposition that he resigned 1871. Some friends organized for him the parish of St. Ignatius, New York, of which he continued rector till his death. He was an able controversialist, and wrote: 'Two Eventful Nights, or the Fallacies of Spiritualism Exposed' (1856); 'Sermons on the Failure of Protestantism' (1869); 'Catholicity in its Relations to Protestantism and Romanism' (1878); 'The Operation of the Holy Spirit' (1880); 'Grammar of Theology' (1880).

Ewers, ū'érz, **Ezra P.**, American military officer: b. New York. He entered the army in January 1862, and after successive promotions was commissioned brigadier-general of volunteers in December 1898; and placed in command of troops in San Luis, Cuba. During the Civil War he distinguished himself at Hoover's Gap and in the battle of Chattanooga, and was brevetted major, 27 Feb. 1890, for gallantry in action against the Indians under Crazy Horse, Tongue River, Montana, 8 Jan. 1877.

Ewing, ū'ing, **Emma Pike**, American educator: b. Broome County, N. Y., July 1838. She was married to W. P. Ewing in 1863. Since 1880 she has been prominent as a teacher of and lecturer on cookery and domestic economy. She conducted a school of cooking in Chicago (1880–3); was professor of domestic economy, Iowa Agricultural College (1883–7), and Purdue University (1887–9). She has also been dean of the Chautauqua Assembly Cooking School (1882–99), and director of the model school of household economics in connection with Marietta College, Ohio (1898). She has published: 'Cooking and Castle Building' (1880); 'The Art of Cookery' (1897); 'Cookery Manuals' (1884); 'Text-books of Cookery' (1898).

Ewing, Hugh Boyle, American soldier: b. Lancaster, Ohio, 31 Oct. 1826; d. there 30 June 1905. He was educated at the United States Military Academy; in 1849 went to California in charge of an expedition sent out by his father, then Secretary of the Interior, to rescue emigrants from the snow-bound Sierras, whence he returned in 1852; practised law in St. Louis 1854–6, and in Leavenworth, Kan., 1856–8. He served through the Civil War, becoming a brevet major-general; was United States minister to The Hague 1866–70, and wrote: 'A Castle in the Air' (1887); 'The Black List' (1893); etc.

Ewing, James Alfred, Scotch engineer: b. Dundee 27 March 1855. From early childhood his mind was bent on the study of scientific subjects, especially mechanical engineering, and after receiving an elementary education at the Dundee High School, he took a course of scientific studies at the University of Edinburgh. For several years until 1878 he was assistant in telegraph engineering, in which year he was appointed to the chair of mechanical engineering at the University of Tokyo, Japan. During his term of five years as instructor there he did much important work in measuring the vibrations of the earth during an earthquake by means of instruments of his own invention. So entirely new, original, and exhaustive were these investigations that in 1883 the university published them under the name 'Earthquake Measurement'; the Seismological Society of Japan also published some of the results of his researches. In 1883 he returned to Dundee, where he became professor of engineering in University College; in 1890 accepting the professorship of applied mechanics at Cambridge. He has published: 'Magnetic Induction in Iron and Other Metals' (1892); 'The Steam Engine and Other Heat Engines' (1894); 'The Strength of Materials' (1899); etc.

Ewing, John, American Presbyterian minister and mathematician: b. Nottingham, Md., 22 June 1732; d. Philadelphia, Pa., 8 Sept. 1802. As a youth he exhibited marked ability in mathematics and later took a course of study in Princeton College, where in his senior year he also acted as a tutor in the grammar school. Upon graduating in 1755 he was appointed instructor in the college. He then became interested in theology and after finishing his course in divinity was licensed to preach by the presbytery of Newcastle, Del. In 1758 he received his appointment as instructor of the philosophical department in the College of Philadelphia and in 1759 became pastor of the first Presbyterian church in that city, remaining such until 1773 when he was sent to England to solicit pecuniary aid in the establishment of an academy. In 1775 he returned to his native land, and in 1779, when the College of Philadelphia was changed to the University of Pennsylvania, he was placed in the station of provost, and officiated in that capacity until his death. He was elected to the vice-presidency of the American Philosophical Society and contributed many valuable articles to its 'Transactions.' He also contributed many articles on astronomical subjects to the American edition of the 'Encyclopædia Britannica.' He was also selected to serve on the commission to establish the Delaware State boundary line, and also to settle the boundary lines between Massachusetts and Connecticut, and Pennsylvania and Virginia. His 'Lectures on Natural Philosophy' (2 vols. 1809), and a collection of sermons were published after his death.

Ewing, Juliana Horatia Gatty, English writer for young people: b. Ecclesfield, Yorkshire, 1841; d. Bath, Somerset, 13 May 1885. She contributed largely to a magazine started by Mrs. Gatty, her mother. On her mother's death the magazine was edited by her and her sister conjointly, and many of her best stories first appeared in it. Of her delightful tales of child-life we may mention: 'Mrs. Over-the-Way's Remembrances' (1869); 'The Brownies' (1870); 'A Flat-iron for a Farthing' (1873); 'Lob-lie-by-the-Fire' (1874); 'Six to Sixteen'; 'Jan of the Windmill' (1876); 'A Great Emergency' (1877); 'We and the World' (1881); 'Old Fashioned Fairy Tales'; 'Brothers of Pity' (1882); 'The Doll's Wash'; 'Master Fritz'; 'Our Garden'; 'A Soldier's Children'; 'Three Little Nest Birds'; 'A Week Spent in a Glass House'; 'A Sweet Little Dear'; and 'Blue Red' (1883); and 'Jackanapes' (1884). A biography by her sister, Horatia K. T. Gatty, was published in 1885 under the title 'Juliana Horatia Ewing and Her Books.'

Ewing, Thomas, American statesman: b. near West Liberty, Va., 28 Dec. 1789; d. Lancaster, Ohio, 26 Oct. 1871. He was graduated at the Ohio University in Athens in 1815; admitted to the bar in 1816; and practised law for 15 years. He was a United States senator from Ohio 1831–7 and 1850–1; secretary of the treasury under President Harrison in 1841; and secretary of the interior under President Taylor in 1849. In the United States Supreme Court he ranked among the foremost lawyers of the nation. During the Civil War his judgment in matters of state was frequently sought by President Lincoln. When the capture of Mason and Slidell brought England and the United States to the very point of hostilities, Ewing sent the famous telegram that was really decisive of the whole trouble: «There can be no contraband of war between neutral ports» — and it was his advice that finally prevailed over Everett's opinion, and the envoys were set free.

Ex Parte, ĕks par'tē (Lat. «from a part»), a law Latin term used in reference to an action taken by either party to a suit or other legal proceeding, or on behalf of such party, without notice to the other. Ex parte evidence or hearings are frequently made use of without being regarded as an infringement of the rights of the opponent. In a derived sense the term indicates a lack of accuracy or impartiality in a statement.

Ex Post Facto (eks pōst făk tō) **Law** (Lat. «from what is done afterward»), one made after an offense and taking effect retroactively. The provision in the Constitution of the United States, Art. I., sec. 9, clause 3, that «no . . . ex post facto law shall be passed,» has been interpreted to refer only to crimes, and in that sense the words are commonly used. The following have been decided to come within the scope of the phrase: Every law that makes an action done before its passage, and innocent when done, criminal, and punishes such action; every law that aggravates a crime, or makes it greater than when committed; every law that changes the nature of the punishment, or makes it greater than at the time the act was committed; every law that alters the rules of evidence so as to make it easier to convict the offender; every law that, while not avowedly relating to crimes, in effect imposes a penalty or the deprivation of a right; every law that deprives persons accused of crime of some lawful protection to which they have become entitled, as a former acquittal. Such laws are therefore contrary to the Constitution. Consult: Cooley, 'General Principles of Constitutional Law in the United States' (3d ed. 1900).

Exactions (from Lat. *exactio,* act of driving out, forcing out, a forced contribution), a legal term of ecclesiastical jurisprudence, used in the Middle Ages to denote such duties or contributions, demanded by the clergy of their parishioners, as were extraordinary, either because they were new and against custom or because their amount was unduly increased. They were illicit, and it was found necessary repeatedly to denounce their unlawfulness. The power of the clergy over their parishioners, or of the bishops over the subordinate clergy was so great that it was easy for them to make the most outrageous exactions. In 589 the third Council of Toledo forbade the bishops *exactiones diociesi vel damna infligare,* and the meaning of this is more exactly defined by Leo IV., who, in 853, forbade the bishops to exact from the clergy and ecclesiastical institutions of their dioceses «dationes ultra statuta patrum aut super appositæ in angariis.» Yet, in 1179, Alexander III. found it necessary to repeat: «Prohibemus ne ab abbatibus vel episcopis, aliisve prælatis novi census imponantur ecclesiis, nec veteres augeantur nec partum redituum suis usibus appropriare præsumant.»

Examiners, Medical, in some States, as Massachusetts and New York, county officials whose duties are practically those formerly discharged by coroners, whom they have superseded. See CORONER.

Exanthemata, ĕk-săn-thē'mạ-tạ, a name formerly widely employed to designate the acute infectious diseases that were characterized by an eruption — the eruptive fevers. The most important of these are measles, scarlet fever, chickenpox, smallpox, typhoid fever, and typhus fever (qq.v.).

Exarch, ĕks'ärk (Gr. ἔξαρχος, *exarchos,* leader), a title equivalent to governor (Lat. *rector*), in the terminology of civil government after the seat of empire was transferred to Constantinople. But already in the 4th century it acquired the signification of archbishop, metropolitan, or patriarch. In the acts of the first Council of Constantinople (381) the bishops of Alexandria, Antioch and Constantinople are styled exarchs; and the field of jurisdiction of an exarchos is exarchia. In the same period exarchos, exarchia were in use as designations of civil magistrates and their jurisdictions, the term diocese (διοικησις, *diôecesis*) was also used. In ecclesiastical usage exarch came in time to be a title of honor apart from jurisdiction; thus, by the Council of Chalcedon (451) the bishops of Ephesus, Heraclea and Cappadocian Cæsarea, though deprived of their jurisdiction over the metropolitans previously suffragan to them, were permitted to be called by the title exarch.

Exauvilliez, Philippe Irenet Boistel D', fē-lēp ē-rē-nā bwäs-tĕl dĕks-ō-vē-ē-ā, French author: b. Amiens 6 Dec. 1786; d. 1858. His essay, 'The St. Gervais Library' (1831), gave the first impulse to the establishment of small libraries all over France. He translated Walter Scott's novels, from which he eliminated every passage which could be interpreted as telling against the Roman Catholic religion, and also all love passages as far as possible.

Excal'ibur, the famous mystic sword of King Arthur (q.v.) which, in accordance with the promise of Merlin, was given him by the Lady of the Lake. At Arthur's death it was hurled by Sir Bedivere into the lake, where it was seized and conveyed from sight by a mysterious hand. Consult: Tennyson, 'Idylls of the King.'

Ex-cath'edra (Lat. «from out the chair»): a phrase originally applied to decisions given by popes or prelates in a solemn judicial manner. Hence it is applied to every decision pronounced by any one in the exercise of his proper authority, as judge on the bench, etc.

Excavator, a machine for digging, moving, and transporting gravel, soil, etc. Excavators are made of two kinds, each adapted for different kinds of work. In making a long cutting, the first to come into operation is operated on rails, and employs a large «scoop» or bucket, with a lever heavy enough to counterbalance the bucket when filled with clay. The scoop is lowered and driven into the bank until full. It is then raised by the suspension chain, and dumped by the chain on the lever. The second class of excavator is employed to make the cutting wider. Its sides are made sloping to an angle of 45°, and on the top of the bank a temporary line of rails is laid a few feet from the edge. The machine is placed on the rails at the end of the cutting; the jib is lowered until the row of buckets it carries can cut into the clay; these scrape up the bank, reaching the top of it full of soil; they next pass over the machine, and are emptied into the wagons beyond it.

Excellency (from Lat. *excellentia,* superiority) a title of honor given to ambassadors, governors of British colonies, and the governor of Massachusetts. The President of the United States and the governors of many of the States have the same title by courtesy. In former times it was applied only to sovereign princes.

Excelmans, ĕk-sĕl-män, or **Exelmans, Rémi Joseph Isidore,** rā-mē zhō'zĕf ē-sē-dōr, BARON, French marshal: b. Bar-le-duc 13 Nov. 1775; d. 10 July 1852. He entered the army in 1791, served with distinction at Austerlitz in 1805, and gained the rank of general of brigade for his conduct at Eylau in 1807. In the Russian campaign (1812) he commanded a division. He directed a corps at the battle of Waterloo, after which he passed four years in exile; was restored to his title as a peer in 1831, and became a marshal of France in 1851.

Excel'sior (Lat. «higher») (1) the motto of New York State. (2) A well-known poem by H. W. Longfellow, published in 1841, of which the opening words are: «The shades of night were falling fast.» The poem in its musical setting became in America a favorite academic song.

Excelsior, the trade name of a material invented in America and widely used for packing and as stuffing in mattresses and upholstery. It is made from logs of wood which have first been divided into 18 inch blocks. The fibres are separated from the blocks with great rapidity by knife-points, and packed in bales of 250 pounds weight. Not far from 45,000 tons are annually manufactured in the United States, and of this output large quantities are exported.

Excelsior Geyser, a geyser in the Yellowstone National Park, and one of the largest in the world. It has thrown a column of water to a height of 200 to 300 feet. See YELLOWSTONE NATIONAL PARK.

Exchange, the act of exchanging or giving one thing for another. The term also signifies that which is so given. In commerce it is applied to a place where merchants, brokers, etc., meet to transact business; it is generally contracted into 'Change. The institution of the modern exchange dates from the 16th century. They originated in the important trading cities of Italy, Germany, and the Netherlands, from which last-named country they were introduced into England. The most celebrated are the Royal Exchange of London, the *Bourses* of Paris and Amsterdam, the Börse of Hamburg, and the New York Stock Exchange in Wall Street. In some exchanges only a special class of business is transacted. Thus there are stock exchanges, corn exchanges, coal exchanges, cotton exchanges, etc. For Bill of Exchange, see BILL.

Course of Exchange is the current price of a bill of exchange at any one place as compared with what it is at another. If for $500 at one place exactly $500 at the other must be paid, then the course of exchange between the two places is at par; if more must be paid at the second place, then it is above par at the other; if less, it is below it. *Arbitration of exchange* signifies the operation of converting the currency of any country into that of a second one by means of other currencies intervening between the two. In arithmetic *exchange* is a rule for ascertaining how much of the money of one country is equivalent in value to a given amount of that of another. In law, a mutual grant of equal interests, in consideration the one for the other is termed *exchange.* In physics the *theory of exchange* is a hypothesis with regard to radiant heat, devised by Prevost of Geneva, and since generally accepted. All bodies radiate heat. If two of different temperatures be placed near each other, each will radiate heat to the other, but the one higher in temperature will receive less than it emits. Finally, both will be of the same temperature, each receiving from the other precisely as much heat as it sends it in return. This scale is called the mobile equilibrium of temperature.

Exchange, an association providing an organized market for transactions in stocks or commodities. Thus a stock exchange deals in the shares or certificates of indebtedness of stock companies, a cotton exchange in cotton, and a produce exchange in grain and provisions. The rules of these exchanges establish a system by which stocks or commodities may be traded in either for investment or speculation; for immediate or future delivery; for cash, that is, payment in full, or to be carried on margin or security representing a certain percentage of the value of the stocks or commodities purchased. This system enables the trader or operator to be either long or short, to buy what he may not have the means to pay for in full, in hopes that he may sell at a profit on rising prices; or else to sell what he does not own, but is able to borrow in order to make delivery, the desire being that prices will decline so that he can buy at a profit, thus returning what he has borrowed.

There are stock exchanges in nearly every leading city of Europe and America, the London Stock Exchange, the Paris Bourse, and the New York Stock Exchange being, by far, the most important, their transactions leading all others in magnitude and scope. In the United States there are stock exchanges in Philadelphia, Boston, Chicago, Pittsburg, Baltimore, Cleveland, Cincinnati, Detroit, New Orleans, Denver, Indianapolis, San Francisco, Washington, Kansas City, Los Angeles, Providence, and Richmond. In Canada there are stock exchanges in Montreal and Toronto. Mining stock exchanges exist in Colorado Springs and Cripple Creek. The principal cotton exchanges are at New Orleans, New York, and Liverpool. The Chicago Board of Trade and the New York Produce Exchange are the leading markets for grain. There are prosperous coffee exchanges in New York and Hamburg. In New York besides the Stock Exchange, there is a rival institution, called the Consolidated Stock & Petroleum Exchange, where there are dealings in stocks, oil, and other commodities. New York also contains, in addition to these two stock exchanges and the Produce, Cotton, and Coffee exchanges, a Maritime Exchange and a Metal Exchange. Chambers of Commerce and Boards of Trade may also be exchanges. For instance the Chicago Board of Trade is the controlling market for grain. But commonly they are not; and the Chamber of Commerce, and the Board of Trade and Transportation, in New York, are in no sense of the word exchanges, no buying or selling taking place within them. They are simply associations of business men for the promotion of commerce and its protection against adverse legislation.

Exchanges are an evolution of modern business. It was not until late in the Middle Ages that anything like the exchanges as they exist to-day were established. At first these were associations of merchants and bankers. The stock exchange is a product of the 18th century, and the produce and cotton exchanges of the 19th century, the system of option trading being a creation of the past 40 years. The Paris Bourse was founded in 1726, and the London Stock Exchange in 1773. The first stock exchange in the United States was founded early in the 19th century in Philadelphia. The New York Stock Exchange was organized in 1817, but the stock brokers had even then been working, for 25 years, under an agreement as to commissions, this agreement having been entered into as early as 17 May 1792. The merchants had a meeting place or exchange on Broad Street near Pearl in 1752. Sixteen years later the Chamber of Commerce was organized. The Tontine Coffee House built in 1794 was for many years the principal market place of the merchants, bankers and brokers of New York.

It is usual for the exchanges and the principal banks to be located in one quarter of the city and this quarter thus becomes the financial centre. In London the Bank of England and the principal banking houses and the stock exchange are located in Threadneedle, Throgmorton, and Lombard streets and Capel Court. In New York the financial district centres in Wall Street; which is a short narrow street reaching from Broadway to the East River. In this street are the Custom House (soon, however, to be moved to Bowling Green), the sub-treasury, the assay office, and many of the banks and trust companies. The financial district has, however, outgrown the narrow area of Wall Street, and takes in Broad, New, William, Nassau, and Beaver streets, and Exchange Place. But still the term «Wall Street» is commonly applied to the entire financial district, in which are located seven exchanges, the sub-treasury, 35 banks, 29 trust companies, and the general offices of fully 500 great railroad, insurance, express, telegraph, mining, industrial, and manufacturing corporations as well as of several thousand brokers. Many of the brokers are members of several exchanges, and there are close business relations between the banks, the exchanges, and the corporations.

Wall Street is not only the financial centre of America, but it is second only to London in the extent and volume of its transactions. Indeed the transactions of its clearing house now exceed those of the London Clearing House. Prof. Bryce in his 'American Commonwealth' says that the operations of Wall Street are vaster, more boldly conceived and executed with a steadier precision than those of European speculators. There are many and marked differences between the London and the New York Stock Exchange systems. These differences are, however, not essential. Both lead to the same result, though by different ways. Moreover both have a common origin in the natural desire of men to invest their surplus earnings in such a manner as to yield the utmost income possible with the largest safety. Formerly, all investments were practically limited to land, but the area of real estate investments is necessarily restricted, and moreover land, in order to be made to yield a profit, must be developed and tilled. This involves labor for which the merchant and professional man have no time or skill. But in the 17th century a new field for investments was opened. In the first years of that century the East India and Hudson Bay companies were formed and toward its close their shares began to be actively traded in. Stocks were thus added to land as objects of investment, and it is of interest to note that it was the shares of trading and promoting companies which formed the basis of the first stock market. For many years past the shares of transportation companies have been the chief objects of speculative interest, but recently the industrial and trading companies, as in the first years of the stock market, are becoming the most active.

Macaulay, in his history of England, gives a brief but graphic account of the beginnings of the London stock market. The step from investment to speculation was easy, and an extraordinary demand for stocks set in, which was met by the creation of many new companies, modeled on the East India and Hudson Bay companies, and as might be expected, many of these new corporations were bogus concerns, the offspring of criminal promotion. Early in the 18th century a remarkable speculation set in in the shares of the South Sea Company in England and of John Law's Mississippi Company in France. When these speculative bubbles burst, the inevitable panic followed, quickly made fortunes were wiped out, and persons who had invested their all, suddenly found themselves penniless. Many were forced into bankruptcy, and loss and distress were widespread.

For upward of a century the stock market of England existed on the curbstones and in the coffee houses of 'Change Alley. It was without habitation or name, or organization, and yet the business transacted was often of immense volume, and most of the terms of speculation, the slang of the market, were coined at that time. At length the need of organization became apparent and the London Stock Exchange was formed.

There was much the same evolution in America although, of course, it came later, and at first on a much smaller scale. The evolution began after the close of the long war for independence. The national government assumed the war debts of the States and the first Congress issued bonds to take these up. Banks were organized. Investments in these bonds and the shares of these banks were made by those people whose incomes were larger than their expenditures. Out of this demand for investment, speculation soon developed, and under a buttonwood tree, near 68 Wall Street, a number of stock brokers began to assemble every day to buy and sell the few then existing securities. As has been said they entered into an agreement, establishing regular rates of commission. For a quarter of a century the stock market thus existed on the Wall Street curb. In 1801 the stocks of three banks and three insurance companies and the bonds (then called stock) of the United States were traded in. In 1818 the market had increased to 29 different issues, including the shares of 10 banks and 13 insurance companies. The chief speculation was in the stock of the United States Bank.

After the organization of the New York Stock Exchange in 1817, the stock market developed rapidly with the expansion of the country. It was not many years before it outstripped the Philadelphia exchange, which had been the pattern on which it had been modeled. Bank, canal and industrial stocks long constituted the market, but in 1830 the first railroad stock was listed. Eight years later London also began to trade in American «rails.» In 1835 there were transactions in the shares of five railroads as well as of a number of bank and insurance stocks. The invention of the telegraph added greatly to the scope and power of the stock market. The establishment of the Bank Clearing House in 1853 contributed largely to its security. The creation of a national banking system in 1863, making New York a central reserve city, has by augmenting the deposits of the New York banks, promoted the expansion of the stock market. After the laying of the Atlantic cable in 1866 London prices began to be daily received in Wall Street, the markets of New York and London were brought closer together and arbitrage dealings between the exchanges of the two cities were established. The stock indicators or «tickers»—these being instruments by which quotations are simultaneously recorded in every banker's and broker's office as soon as made in the exchange — were adopted in 1867. Telephones were introduced in 1878.

The Exchange moved from place to place during the first 50 years of its life. It met for several years in the Tontine Coffee House and later in the Merchants Exchange (now the Custom House). Still later its board room was in Lord's Court. It was not until 1865 that it occupied a building of its own in Broad Street. Its earlier methods seem very primitive and crude compared with those of to-day. Its great defect consisted in the lack of a continuous market and in the secrecy with which its business was transacted and its quotations guarded. Still a very active speculation was developed, and during the Civil War the transactions overflowing the regular exchange, were carried on in the streets and were continued in the evening in the corridors of the Fifth Avenue Hotel and in uptown exchanges. The business was indeed larger outside of the exchange than in it. In 1864 a rival exchange was organized, known as the Open Board of Brokers. This was in 1869 consolidated with the older institution, and from this date the history of the Stock Exchange substantially as it now exists, begins. Radical changes were then made in government and methods, the most important being the establishment of a continuous market within specified hours, trading outside of those hours being prohibited. In 1892, the Exchange added to its mechanism a stock clearing house, which by eliminating unnecessary deliveries and reducing the number of certified checks employed in payment for stocks, has diminished the over-certification required by the brokers from the banks, and has thus expanded indefinitely the capacity of the Exchange to transact business. In 1903 the Exchange further increased its capacity by the erection of a new building containing a board room 138 feet long by 112 feet wide and 80 feet high, with every convenience of lighting, heating, and ventilating. So rapid had been the growth of its business in the preceding seven years that the Exchange imperatively needed the larger plant thus provided.

Since its organization in 1817 the Exchange has passed through a series of panics, the most severe having been those of 1837, 1857, 1873, and 1893. In 1873 the panic was so disastrous that the Exchange was compelled to close its doors for 10 days. There were briefer and less severe crises in 1818, 1826, 1848, 1866 and 1884. All these were periods of commercial reaction, the effects of which were felt all over the country, and indeed in all parts of the world. But there have been many periods of excitement in the market that were confined almost entirely to the arenas of the stock exchanges alone. The most notable of these was Black Friday, 24 Sept. 1869, which date marked the collapse of the celebrated gold conspiracy of that year. No other day in Wall Street history has equaled that in its concentrated excitement and passion and its wide contrasts of hopes and despair. The suspension of the Barings in London in 1890 produced a severe convulsion in the stock markets of Europe and America. In December 1895 the London and New York exchanges were convulsed by a sharp fall in prices as a consequence of President Cleveland's Venezuelan message, which contained a clause that seemed to threaten war between the United States and England. The excitement died out and the markets recovered their equilibrium as soon as it appeared that war would be averted. Another notable day in Wall Street was 9 May 1901, when the Northern Pacific corner and panic resulted in a collapse of prices, and the heaviest day's transactions on record, the total sales of stocks having been 3,336,695 shares.

As the New York Stock Exchange is the most important institution of its kind in the United States, and one of the three most important in the world, a description of its mechanism will answer for all the others. Its membership is limited to 1,100. Vacancies occur only by reason of death, resignation, insolvency or expulsion for fraud. A membership or «seat,» as it is called, is a valuable asset, and can be transferred by sale to any one approved by the governing body of the Exchange. The price of seats vary, being high in time of speculative activity and low in periods of stagnation. In 1871 seats were sold at $2,750. In 1885 the price had advanced to $34,000. In the dull year of 1896 it was as low as $13,000. Late in 1901 and early in 1902 it reached the high point of $81,000. In 1903 seats were sold at $60,000. The price of seats is a good index to stock market activity. Besides the price of a seat the applicant for membership must pay an initiation fee of $1,000. He must be a citizen, of legal age and receive 10 affirmative votes out of a committee on admissions composed of 15 members.

The London Stock Exchange has upward of 5,000 members, who are re-elected every year. Applicants for election must be recommended by three members of fours years' standing. Unlike the New York Exchange, the London institution admits to its floor a large number of apprenticed clerks of members, and these clerks may, after four years' service, themselves become members on fulfilling all the requirements governing admission. The Paris Bourse is composed of 60 agents de Change. To secure election, the applicant must be recommended by his predecessor and approved by the authorities of the Bourse and the minister of finance.

The membership of the New York Stock Exchange represents many parts of the United States. Bankers and brokers doing business in Chicago, Philadelphia, Boston, St. Louis, Buffalo, Detroit, and other cities are included in it. Many well-known financiers, as for instance, John D. Rockefeller, George J. Gould, E. H. Harriman and Russell Sage are members. But there are other capitalists equally prominent, as for instance, J. Pierpont Morgan and Jacob H. Schiff, whose names are not on its rolls. Such men as have been named, whether members or not, do business through those members who serve as brokers. Only about one half of the members act directly for outside speculators and outside investors. The others are either capitalists whose memberships enable them to have their orders executed at reduced commissions, or "room traders," who speculate on their own account, or "two dollar brokers," who execute the orders of other brokers, or "specialists," that is, men who are expert in certain inactive securities of which they make a special study.

The Exchange requires of its members the most honorable conduct and imposes severe penalties for fraud. It requires its members to maintain certain established rates of commission. For outsiders the rate is one eighth of 1 per cent, which amounts to $12.50 on 100 shares having an aggregate par value of $10,000. Business is done by members for members, who do not give up the names of principals at 1-32 per cent, and for members naming their principals, at 1-50 of 1 per cent, or $2 per 100 shares. The exchange is open every business day at 9.30 A.M., but no business is allowed until 10 o'clock. The sessions last until 3 P.M., except on Saturday, when the close is at noon. There is a chairman, but his duties are simply to open and close the sessions, make any necessary announcements, such as insolvencies and deaths, and to maintain order by fining members guilty of unruly conduct.

There are no "calls" and no formalities whatever. The members simply meet on the floor and those having stocks to buy or to sell make oral announcement of the fact, together with the amount and the price. Prices are made in fluctuations of eighths of 1 per cent, and no seller can offer stocks down more than one eighth of a point at a time. In the Board Room are a number of posts on which the names of the more active stocks are recorded and transactions in these stocks take place around these posts. All transactions are by word of mouth, the brokers simply recording the sales on little pads and communicating them to their offices by telephone. Nowhere else in the world is a man's oral promise so faithfully fulfilled as in a stock exchange. The sales, as made, are obtained by a corps of official reporters, and are immediately recorded on the "tape" of the stock indicator, of which there are about 1,800 in different offices and hotels throughout the city. The "tape" is a narrow ribbon of paper which feeds itself into the indicators and after receiving the printed impressions giving the sales and prices made in the Exchange, falls into baskets placed under the machine. No stocks or bonds are actually exchanged in the board room. All that takes place there are oral promises to deliver or receive a certain number of securities at a certain price. The actual delivery, if the transaction is "regular," must be made before 2.15 P.M. on the day following the sale. Transactions, however, may be made for delivery the same day, or for 3 days later, and there are buyers or sellers' options for not less than 4 or more than 60 days. No fictitious sales are permitted. Transactions are commonly for 100 shares or multiples thereof. The certificates of stocks must be in approved form for acceptance on delivery. Not later than one hour after the close of the Exchange the seller is obliged to compare or endeavor to compare each sale at the office of the buyer. All active stocks pass through the clearing house of the Exchange.

A stock clearing house was first established in Frankfort in 1867, and was speedily adopted in other European cities, and later in Philadelphia, but it was not until 1892 that it was put into operation in New York. Its success there is shown by the fact that in the great year of speculation of 1901 the number of shares cleared, both sides, including balances, was 926,347,300, having a value of $7,853,500,000. Clearances reduced the actual deliveries to 134,391,000 shares, having a value of $10,930,853,000. The check certifications that were obviated amounted to $17,065,042,800.

All sales made at the Exchange are for actual delivery and for payment in full on delivery. The broker carries stock for his customer on margin, which is usually 10 per cent of the market price, but the broker himself pays for the stock in full. In order to do this he deposits these securities with a bank, trust company or other lender of money as security for a loan. The lender usually requires from the broker a margin of 20 per cent. The process of speculation in brief, thus proceeds as follows: The customer orders his broker to purchase a certain number of shares at a certain price, or at the prevailing market price, at the same time depositing with the broker a sum of money equal to at least 10 per cent of the value of the stock. The broker immediately executes the order on the floor of the exchange. He compares the transaction with the broker who sold him the stock within one hour after the close of the Exchange. The transaction, if in an active stock, then passes through the clearing house. Unless it is eliminated by the clearing, the broker selling has to deliver the stock before 2.15 P.M. the following day, the broker buying giving a certified check, in full payment for the same. He then takes the stock and obtains a loan upon it from a bank. In this way transactions may be extended almost indefinitely, the only limit being the capacity of the banks to extend the necessary credit. The customer who has bought the stock may order it to be sold when the price has advanced, and his profit is the difference between the purchase and the selling price, minus the broker's commission and interest on the credit he has obtained.

If the operator sells for a decline in price the transaction is the reverse of this, although it follows substantially along the same lines. In this case stock is sold which the customer does not own. The broker, however, borrows the shares from another broker in order to make delivery, and when the price declines, if the customer so orders, he buys to cover the shortage, the profit to the customer being the difference between the selling and the buying prices, less commissions and interest. Speculation is mostly in the common stocks, preferred stocks and bonds being, as a rule, of the investment class. Investment, as distinguished from speculation, means the purchase of securities, paying for the same in full, and keeping them in safe deposit vaults for the income they yield to the purchaser.

The speculative transactions vastly outnumber the investment. In 1910 the sales of stocks aggregated 163,970,440 shares, while the bonds sold aggregated in par value $634,746,503. This was the smallest number of shares sold since 1903, and the smallest value in bonds since 1907.

The Exchange has strict regulations governing the admission of securities to the privileges of its market, and requires a large degree of publicity in regard to their financial condition from the corporations applying for the privileges of the list. The Exchange, however, has an unlisted department in which stocks and bonds which do not conform to these regulations may be traded in. Such unlisted securities labor, however, under some disadvantages, the banks often discriminating against them in the making of loans. There were approximately 1,300 different stocks and bonds admitted to dealings in the listed and unlisted departments, these having an aggregate value of about $18,000,000,000. Less than 8 per cent belonged to the unlisted class. Securities not admitted to the Stock Exchange are traded in on the curb. The curb market requires the services of over 100 brokers and at times does an active business.

The Stock Exchange has a language of its own, the processes of speculation requiring many terms not commonly used in other lines of business, though some of them are now being generally adopted throughout the country. A «bull» is one who buys in anticipation of higher prices. He is «long» when he has bought or «loaded up» with a «line» of stocks. He sells to «realize» his profits, or is «wiped out» when his «margins» are exhausted. A «bear» is one who sells in anticipation of lower prices. He is «short» when he has thus sold what he does not own. He «covers» when he buys to realize his profits, or to protect himself against further loss in case prices advance instead of decline. He is caught in a «corner» when he finds that he cannot buy in order to make good the stock he has borrowed for delivery, the return of which has been demanded. He is then obliged to settle practically at a price fixed by those to whom he and other shorts have sold. «Lambs» are novices in speculation, and they are well «sheared» when the professional operators have succeded in relieving them of their margins. A «bucket shop» is a bogus brokerage establishment where there is no actual transfer of securities, but where bets are registered on the course of prices. These are a few of the best-known Wall Street terms. There are, however, many others.

The other stock exchanges in the United States are commonly conducted on the same system as that of the New York Stock Exchange. Their business, however, is for the most part in local securities, while the New York Stock Exchange is national in its scope, its market including the securities of the entire country, and a very few of other nations. The methods of the London Exchange are quite different. There the settlements are made every two weeks. In New York they are made every day. In London, there is a system of jobbers and brokers which is unknown on this side of the water. The jobbers are the wholesalers and the brokers the retailers in stocks. The brokers deal with the public, and the jobbers only among themselves and with brokers. The term «stock jobbing» springs from this system. The New York Exchange is governed by a governing committee elected by the members. This committee has almost absolute power like the directors of a corporation. There is a president elected every year. Governors serve four years, but their terms are so arranged that one fourth of their number retire each year. The London Exchange is controlled by a stock company, commonly called the «house,» having £240,000 capital, the shares being held by about one fifth of the members of the exchange. No more than 200 shares can be owned by one member.

Exchanges dealing in grain, cotton and coffee employ a system of which the principles are the same as in the stock exchange though worked out somewhat differently. Actual delivery of all product sold is contemplated in every trade, although the number of deliveries is reduced by clearances involving the settlement of differences. Brokers carry the grain, cotton or coffee for their customers on margin. The products may be bought for immediate or cash delivery or for delivery at some future period. The «option» system, as it is called, involves this principle of purchases for delivery months ahead. For instance, grain may be bought in March for delivery in December. Contracts mature on the last day of the month. If not settled for then, there is a default of contract. The established brokers' commissions for round trades, that is to say, for buying and then selling (thus completing the transaction), are $6.25 per 5,000 bushels of grain; $10 per 100 bales of cotton, and $20 per 250 bags of coffee. The usual margins demanded are, on grain, $250 per 5,000 bushels; on cotton $100 per 100 bales; and on coffee $325 per 250 bags.

The difference of one «point» in the price of stock amounts to $100 per 100 shares. The difference of one eighth of a cent a bushel in the price of grain amounts to $6.25 per 5,000 bushels. A point in cotton is one one-hundredth of a cent and amounts to $5 per 100 bales of 500 pounds each.

Ever since the first stock market was established, numerous attempts have been made to limit its operations and reduce the evils of over-speculation by legislation. The English Parliament passed an act to suppress stock jobbing in 1734. About 10 years ago an effort was made in this country to prohibit option dealings in agricultural products by law, and it has several times been proposed to restrict the operations of the stock exchanges by heavy taxation of all margin transactions. Legislation of this character has, however, failed of passage in the United States. In Germany, however, in 1894, laws were passed which greatly reduced speculation on the Berlin Bourse and for a time closed the Produce Exchange. So injurious was this to the financial and agricultural interests of Germany that the government is strongly in favor of the repeal or amendment of the law, and has in fact largely modified its enforcement. Those interested in this branch of the subject may read with profit an article on the Berlin Bourse which appeared in the ‘Century Magazine’ of September 1903. A powerful defense of the functions of the stock exchanges against the many criticisms which have been made upon them was given in an article in the ‘Atlantic Monthly’ early in 1903, written by Charles A. Conant. Books on Wall Street are not numerous, although there are many volumes of statistics, and brokers often issue works of reference and advice in the art of speculation. One of the earliest books which I have seen relating to Wall Street was issued in 1837, and is entitled ‘A Week in Wall Street.’ It gives an account, although an inadequate one, of the then existing mechanism of the exchange. An excellent ‘History of the New York Stock Exchange’ by its former president, Francis L. Eames, was printed in 1894 for private circulation, and is now out of print. A comprehensive account of the London Stock Exchange is contained in Charles Duguid's ‘The Story of the Stock Exchange’ (1901). The general description of the entire mechanism of Wall Street, with a history of its evolution, is given in ‘The Work of Wall Street,’ by Sereno S. Pratt (1903). Several excellent little volumes have been issued by S. A. Nelson entitled, ‘The A B C of Wall Street’; ‘The A B C of Stock Speculation’; ‘The Theory of Stock Speculation’; etc. The best account of the laws governing speculative transactions is given by John R. Dos Passos' ‘Treatise on the Law of Stock Brokers and Stock Exchanges’ (1882). George R. Gibson has issued several pamphlets describing the operations of the European exchanges. Those interested in the history of speculation in the United States will find entertaining matter in Henry Clews' ‘Twenty-eight Years of Wall Street.’

The exchanges are described by many writers as simply gambling establishments, but speculation has its uses as well as its abuses. One of its advantages is to give mobility to capital, which is thus enabled to turn quickly from one enterprise to another. Thus have the achievements of centuries been crowded into as many decades. There is no doubt that the exchanges, notwithstanding the great evils of over-speculation, have contributed mightily to the rapid development of America.

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Exchequer, ĕks-chĕk'ẽr, in Great Britain, the department which deals with the moneys received and paid on behalf of the public services of the country. The public revenues are paid into the Bank of England, or the Bank of Ireland, to account of the exchequer, and these receipts as well as the necessary payments for the public service are under the supervision of an important official called the controller and auditor-general. The public accounts are also audited in his department.

Exchequer Bills, bills of credit issued by authority of the British Parliament as a means of raising money for temporary purposes. They are of various sums — £100 or any multiple of £100 — and bear interest (generally from 1½d. to 2½d. per diem on £100) according to a rate fixed at the beginning of each year. These bills pass from hand to hand as money, and form a principal part of the public unfunded debt of Great Britain. Exchequer bonds are similar, but they run for a definite number of years at a fixed rate of interest.

Exchequer, Chancellor of the. See CHANCELLOR.

Exchequer, Court of. See COURT.

Exchequer Tallies, seasoned wands of ash hazel or willow, formerly used for checking accounts in the English exchequer. Notches cut on the tally indicated by their form the class to which the account belonged.

Excipient (from Lat. *exipere,* take up, undertake), in pharmacy, an inert substance used to give form and consistence to solid preparations, such as pills, or to give palatability and the necessary qualities for administration to any medicine. The various conserves, also honey, treacle, simple syrups, glycerin, white of egg, and mucilage of acacia are among the most useful excipients.

Excise, a government inland duty or impost laid on commodities consumed, or on their retail, which is the last stage before consumption. Many articles, however, are excised at the manufactories. The word seems to be derived from a Dutch term of similar meaning, which in turn may be of same origin as *assize,* its present form being influenced by a supposed derivation from Latin *excisus.* For a more detailed explanation of excise, see CUSTOMS; INTERNAL REVENUE.

Excise Laws, in the United States. The long struggle of the English people against excise was not due to any intrinsic iniquity in the tax, but partly to popular dislike of all direct taxes (see CUSTOMS; TARIFF); partly to the inquisitorial methods involved, partly to their use as a means of strengthening the royal power against popular control. At any rate, the colonists inherited this unreasoned dislike, even under totally different conditions; though Connecticut had laid an excise on spirits and all use of foreign articles, and Massachusetts and Pennsylvania on spirits, before the Revolution. But all shrank from giving the national government such power, and several States proposed amendments to the Constitution forbidding the United States ever to lay excises. Hamilton, however, recommended to Congress in 1790 an excise on spirits, upon the most advanced modern grounds — that it would not only produce a revenue without burdening any worthy industry or person, but would check the consumption, to the great advantage of the community. With great opposition the law was passed, imposing a duty of 9 to 25 cents a gallon (according to strength) on all native spirits, and a higher one on imported. In 1792 the tax was lowered somewhat. Later, under Hamilton's advisement, the scope was extended to other articles of luxury, auction sales, stamp duties on instruments of exchange, etc. But it was nullified in some sections by passive resistance; at last in 1794 a furious open defiance began in Pennsylvania (see WHISKEY INSURRECTION), which had to be quelled by the regular army. There was no further resistance, but no cessation of the dislike, which was naturally a Democratic tenet, from the power it gave the general government; and when Jefferson became President, on his recommendation Congress abolished the entire system, which was possible from the large increase in customs receipts. The War of 1812, however, necessitated a fresh resort to it; and duties were laid on spirits (license tax), and the same articles Hamilton had chosen — sugar, carriages, auctions, and exchanges — with salt added. They were repealed in December 1817, and no further excises were levied till the system of internal revenue taxes (q.v.) was adopted in 1862.

Excito-motor Action, the action of nerves distributed to muscular organs the stimulation of which leads to movement. Thus, irritation of a nerve supplying a muscle will lead to contraction of the muscle by excito-motor action, and irritation of certain nerves distributed to blood vessels will lead to contraction of the vessel by acting on its muscular coat. See NERVOUS SYSTEM.

Exclusion, Bill of, a bill introduced into the British Parliament during the reign of Charles II. for the purpose of excluding the Duke of York, he being a Roman Catholic, from the throne. See CHARLES II.; JAMES II.

Excommunication, an act of ecclesiastical jurisdiction whereby a Christian is separated from the communion of the Church. This power was exercised by the Apostle Paul when in his first letter to the Corinthians, ch. v., he writes concerning a man guilty of incest that he «delivers such a one to Satan.» Authority for excommunication is found in the words of Christ reported in Matt. xviii. «If he will not hear the church let him be to thee as the gentile and the publican.» In the Roman Catholic Church there are two degrees of excommunication — major and minor. By the minor an offender is deprived of the use of the sacraments; by the major one is deprived of all manner of communion or communication with the faithful. In the times when the laws of the Church were enforced in their primitive rigor, the excommunicated were denied communication with the faithful not only in sacred things but in the common life. This is greatly modified now, and persons who have incurred the uttermost ecclesiastical censures suffer only the spiritual penalties attached to their offenses. But though the Church's excommunication has in the present time lost all its civil effects, a brief notice of these effects is necessary for an appreciation of the condition of an *excommunicatus vitandus,* that is, of a person under the major excommunication, who must be avoided by the faithful, under penalty of themselves incurring the minor excommunication.

A person who is under the major excommunication is disqualified for acting as judge or juror, notary, witness in courts of law, advocate, attorney; but he is competent to plead his own cause and to sue others on his own behalf. He cannot be a guardian of a minor, nor curator, nor executor of a last will, nor can he make contracts. He cannot act as a legislator. After death his body is deprived of Christian burial: and if it does get burial in consecrated ground in whatever way, it is to be dug up and cast out. The excommunicate under major excommunication must be shunned by all the faithful: they must not, under pain of excommunication (minor), communicate with him either by word of mouth or by writing; must not greet him, nor have exchange of gifts with him. If an *excommunicatus vitandus* happens to enter a church while the Mass is proceeding, he must forthwith be put out; if that cannot be, then the service must be suspended. Such is the letter of the laws; but long before these stern prescriptions went into desuetude there were notable assuagements of their rigor through the interpretations of moralists. To illustrate this by one example only: The serfs and servants and the children, grandchildren and other relatives (even by affinity only) were permitted to continue their relations of obedience and respect to their head even after he was excommunicated.

Excretory System, Comparative Anatomy of the. See ANATOMY.

Execu'tion, in law, the carrying into effect the final judgment, decree, or order of the court. Execution is effected by a writ or order directed to the proper officer and commanding him to do a certain thing. In civil law it is the means of obtaining that which the court ordered to be done by one of the parties. Execution may be had for either plaintiff or defendant. When taken out by the plaintiff it depends on the cause of action as to what is to be recovered under the writ; generally it is for the debt and costs, or for the goods, damages, and costs. When taken out by the defendant it may be for goods, damages, and costs, and in some cases it may be only for costs.

As soon as final judgment has been entered, the party entitled to it may take out his writ of execution, and he is entitled to this writ until the other party has taken some step which is a *supersedeas,* such as an appeal or writ of error. The writ issues from the court which last passed on the judgment on which the writ of execution is taken out. Execution may be against personal property, taking and selling it, or it may be against real estate, either holding it until the judgment is paid, or selling it, or in some cases by the seizure of the person of the defendant and holding him until the judgment is satisfied, or until he is declared insolvent. If the property is sold the fund derived from the sale is applied to paying the judgment and costs, and the surplus, if any, is returned to the former owner of the goods. A writ of execution, although issued at the instance of the party in whose favor the judgment is, must be directed to the sheriff, who must carry out the direction of the writ. If he fails to do so he must answer in damages to the injured party. When the execution is against personal property, such as goods and chattels, the writ of *fieri facias* is used. When the personal property consists of choses in action it is reached by a writ of attachment. If the execution is against real estate a writ of *scire facias* is used, and it is sold under a writ of *venditioni exponas.* In some cases, when the judgment is confined to a particular piece of real estate, the writ of *levari facias* is issued first, and it is sold under a writ of *venditioni exponas.* If the execution is against the person of the defendant a writ of *capias ad satisfaciendum* is issued, under which the defendant is arrested and his person held until the judgment is satisfied, or until the defendant is declared insolvent. Sometimes the defendant is released if security is given that the defendant will abide by the order of the court.

A general judgment binds all property owned by the person against whom the judgment is recovered at the time the judgment is entered, and it also attaches to all property he acquires up to the time the judgment is satisfied, and if the debtor sells any real estate before the judgment is satisfied, the property is not released from the lien of the judgment. When property is sold under an execution the purchaser only buys the title of the debtor, and all equities under which he held it still attach to the property.

In the criminal law execution is the carrying into effect the judgment of the court in relation to the person convicted. It consists in putting the convict to death according to his sentence. See CAPITAL PUNISHMENT.

Execu'tioner, the official who carries into effect a sentence of death, or inflicts capital punishment in pursuance of a legal warrant. In England it is the province of the sheriff to execute the extreme sentence of the law, but in practice the disagreeable duty is performed in his presence by an officer retained for this purpose. In Scotland the duty devolves upon the civic magistracy, but the strict letter of the law is avoided as in England by the attendance of a magistrate to witness the proceedings. Several executioners have become famous from their names being dragged into literature; such as Richard Brandon, the supposed headsman of Charles I.; Jack Ketch, commemorated by Dryden (Epilogue to the Duke of Guise), whose name was long vulgarly given to all who succeeded him (in London) in this odious office. In America, the title and duties of the public executioner differ in the various States. In some States the sheriff of the county becomes the executioner, but in New York State the warden of the penitentiary is technically the executioner. The duties are usually performed by one of his subordinates. In the army the provost-marshal is the military executioner. See CAPITAL PUNISHMENT; ELECTROCUTION; GUILLOTINE; HANGING.

Exec'utive, in the United States, properly the entire official body charged with the execution of the laws, from the head to the lowest subordinate; but in current use, restricted to the head officer, as President (of the United States), governor (of a State), mayor (of a city), etc. (See CABINET.) The general executive of the colonies was the king; their individual executives, the governors, appointed by the crown or (in Rhode Island and Connecticut, and for a few years in Massachusetts) chosen by the people. These were succeeded *de facto* by the committees or councils of safety; then by officials usually called governor, sometimes president, and sometimes not by single persons, but by executive councils as in Switzerland. The general government had no executive till the adoption of the Constitution. The Continental Congress had only such functions as the State legislatures allowed it, which were to debate and ask for supplies and make recommendations, and the Articles of Confederation provided for no executive. The Constitution, although it gives the President large executive powers, compels him to share the most important, as appointments and treaties, with the Senate; it was only after debate, indeed, that a single executive was resolved on, there being a strong sentiment in favor of a plural executive representing different sections of the Union, and three States voted in favor of the latter in committee of the whole. (For the steady encroachments of Congress upon the President's executive powers, see CONGRESS.) The question of succession of executive power in case of the death or disablement of the chosen executive has been elaborately provided for by statute: in case of the President, first by succession of the Vice-President, then by a series of devolutions upon the various officers of the Cabinet, beginning with the secretary of state — so that nothing but a successful Gunpowder Plot, or rather a number of simultaneous ones, could paralyze national executive authority. The embarrassing cases of possible lunacy, paralysis, etc., have never arisen, nor has capture by the enemy; though the latter has twice been imminent — of Madison by the British in 1814, of Lincoln by Booth (the original plan) in 1865. But cases which have not occurred in 114 years may be left to deal with when they do occur. (For the problems of presidential elections, see ELECTORS; ELECTORAL COMMISSION.) The executive departments were first created in 1781 — Foreign Affairs, Finance, War, and Marine; previously, their work had been done by Congressional committees, or commissions appointed by them. They were reorganized in 1700.

Exec'utor (Lat. «performer»). An executor is one to whom another man commits his last will and testament for execution of that last will and testament (2 Black. Comm. 503). A person to whom a testator by his will commits the *execution,* or putting in force, of that instrument and its codicils. The following is a brief summary of an executor's duties:

(1) He must bury the deceased in a manner suitable to the estate left behind. But no unreasonable expenses will be allowed, nor any unnecessary expenses if there is risk of the estate's proving insolvent. (2) Within a convenient time after the testator's death, he should collect the goods of the deceased, if he can do so peaceably; if resisted he must apply to the courts for relief. (3) He must prove the will, and take out administration papers. (4) Ordinarily, he must make an inventory of personal property, and, in some States of real estate also. (5) He must next collect the goods, and chattels, and the claims inventoried, with reasonable diligence. And he is liable for a loss by the insolvency of a debtor, if it results from his gross delay. (6) He

must give notice of his appointment in the statutory form, and should advertise for debts and credits. (7) The personal effects he must deal with as the will directs, and the surplus must be turned into money and divided as if there was no will. An administrator must at once collect, appraise and sell the whole. The safest method of sale is a public auction. (8) He must keep the money of the estate safely, but not mixed with his own, or he may be charged interest on it. (9) He must be at all times ready to actually file an account within the year generally prescribed by statute. (10) He must pay the debts and legacies in the order required by law. Funeral expenses are preferred debts. See ESTATE.

Exegesis, Biblical. The world "exegesis" is from the Greek ἐξήγησις, primarily *a leading out,* and coming to mean, *an interpretation, an explanation, a making clear.* The verb ἐξηγέομαι occurs six times in the New Testament, always in the sense of revealing a fact or making clear a truth, Luke xxiv. 35; John i. 18; Acts x. 8; Acts xv. 12, 14; Acts xxi. 19. In John i. 18, we read, "No man hath seen God at any time; the only-begotten Son, who is in the bosom of the Father, that one became his exegete" (ἐκεῖνος ἐξηγήσατο). That is to say, Jesus *revealed* the inmost character of God. He *made manifest* what otherwise would have remained hidden. He *interpreted* God's being. He *made clear* the Divine providence and plan. His person and his whole teaching and life were an exegesis of the invisible and previously incomprehensible Godhead. What Jesus did for God's being and providence, the exegete endeavors to do for the Bible. He searches for its inmost meaning, explains what is obscure, leads out to the light what is less manifest, makes clear all its implications, and sets its complete import before the mind's eye. The task of Biblical exegesis, therefore, is to clear up all difficulties and to make plain the meaning of the Bible text. It might seem a comparatively easy thing to do this; but centuries of endeavor have shown that while all the essentials of the revelation in the Bible are reasonably clear there are problems connected with all of the Bible books which tax the utmost powers of the greatest minds to master them. Then at least four temptations beset the interpreters of Bible truth. One of these is apparent in those exegetes who

> "Each dark passage shun
> And hold their farthing candle to the sun."

What is clear in itself needs no further explanation. The office of the exegete becomes a necessity only when the meaning seems obscure. Another danger in exegesis is that of bringing a meaning *to* the text instead of drawing the meaning *from* it. The text is forced into agreement with previous prejudice or opinion. This is nearly always fatal to the truth. As an old monk said, "Whosoever seeketh an interpretation in this book shall get an answer from God; whosoever bringeth an interpretation to this book shall get an answer from the devil." Jerome put the same truth more mildly when he said, "He is the best teacher who does not bring his doctrine into the Scripture but out of the Scripture." Sometimes the obvious meaning of the text is unpalatable to the exegete, for doctrinal or other reasons, and then he is tempted to explain the meaning away. This is rankest treason to his calling. He is expected to be loyal to the truth and nothing but the truth. If he betray the truth in behalf of a political party or a church organization or a doctrinal system he is no longer worthy of his office or name. A fourth temptation is that of adding to that which is written, improving upon the text by the addition of unwarrantable inferences and subjective fancies and unjustifiable subtleties of every sort. It represents the presumption of the apostle Peter at Cæsarea Philippi, who thought he knew better than his Lord what ought to be said and done. These are four fundamental faults of all exegesis; a failure to explain the meaning that is obscure, a distorting of the meaning that seems obvious, an utter perversion of the plain truth, and a supplanting of the truth with merely human verbiage or wisdom. Wilful miscarriage, maiming, murder, and the substitution of a changeling for the true child are crimes in the realm of interpretation, as well as under the civil law. The science of exegesis has sought from the first to free itself from these faults. If it has not wholly succeeded as yet, that is simply to acknowledge that like all other science its development has been entrusted to fallible men. We may trace various schools of exegesis through the history of the Church, and in all of them some one or other of these fundamental faults is likely to be manifest.

The first important school of exegesis was founded at Alexandria, and it flourished from 150 to 400 A.D. Its most distinguished representatives were Clement, Origen, Athanasius, Basil, and the two Gregories. Of these the peerless prince was Origen, the greatest scholar and saint the Christian Church has produced since apostolic times. A great injustice has been done both him and the Alexandrian school by associating their names almost exclusively with the allegorical interpretation of the Scriptures, in which they sometimes indulged, as though this method were their only method or were peculiar to them alone. Neither of these things was true. The allegorical interpretation was much older than the Alexandrian school and has persisted in dragging out its pernicious existence to this day. It was prevalent and predominant in the Rabbinical schools of exegesis before the Christian era began. The Talmudists finally found a watch-word for their mystical exegesis in Pardes, or Paradise. The four letters of this word in the Hebrew, P R D S, were made to indicate the four words, Peshat or explanation, Remes or hint, Darush or homily, and Sod or mystery; and these in turn represented the four-fold interpretation of which every passage in Scripture was capable. Rabbi Ishmael declared that by means of these any Scripture could be expounded in forty-nine ways and the expositor could break every text into fragments, even as a rock is broken by a hammer (Sanhedrin, 34). The apostle Paul carried at least one example of allegorical treatment into our New Testament, probably suggested by his Jewish training in the school of Gamaliel, Gal. iv. 22-31. This method was introduced into Alexandria by Aristobulus and pseudo-Aristeas, and it became authoritative as a method of exegesis under Philo, the foremost writer among the Alexandrian Jews contemporary with the Christ. Philo found the method ready made to his hand, not only by the Jewish rabbis, but also by the Greek philosophers who had allegorized Homer and Hesiod and the ancient Greek myths into conformity with their more advanced ethics and faith. The Alexandrian church fathers thus found the allegorical interpretation in vogue among their heathen and Jewish neighbors and forbears. They believed it had a Scriptural sanction. They accepted it without question. Their genius and wide influence gave it a standing in the Christian Church for centuries; but the Alexandrian school never had a monopoly of its use. It is unfair, therefore, to hold them responsible, either for the origination or for the promulgation of this method of Scriptural interpretation. Origen did teach that there was a three-fold sense in Scripture, corresponding to the body, soul, and spirit in man—a literal and a moral and a mystical sense. But Jerome also made it a rule that the Scripture should be interpreted in three ways, historically, tropologically, and spiritually; and he related this three-fold division to the doctrine of the Trinity. And Augustine formulated one principle of his exegesis in these words, «Whatever there is in the word of God that cannot, when taken literally, be referred either to purity of life or soundness of doctrine, you may set down as figurative» ('De Doctr. Christ.' III. ch. 10. sect. 14). He wrote to Honoratus, «All that Scripture, therefore, which is called the Old Testament, is handed down four-fold to them who desire to know it, according to history, according to ætiology, according to analogy, according to allegory» ('De util. credendi,' 5). This four-fold division was adopted by many of the church fathers and found its final formulation in the famous couplet of Nicholas of Lyra,

Littera gesta docet, quid credas Allegoria,
Moralis quid agas, quo tendas Anagogia.

A good example of this four-fold sense was the Scriptural use of the word, Jerusalem. Literally, it was a city; allegorically, the church; morally, the individual believer; anagogically, the heavenly state.

This much may be said for the Alexandrian school in connection with the allegorical interpretation of the Scripture. (1) It did not originate this method. (2) It never exercised any monopoly in its use. (3) It found what seemed to it a sufficient sanction in the typology and allegory of the Apocalypse, the Pauline epistles, and the epistle to the Hebrews. (4) No other method of interpretation would have availed them, in their stage of Biblical knowledge and in their environment, for the defense of many portions of the Old Testament. Their adequate apology for yielding to the fourth temptation mentioned above is to be found in the necessities of their case. (5) Their use of this method grew out of their very piety and spirituality. These simply joined forces with their poetical imagination and philosophical insight in the endeavor to save the Scripture from contemporary disrepute. (6) They never used the allegorical method dogmatically and they avoided most of the excesses of the later day. «They are always intelligent and reasonable. They evaporated the letter; they did not stereotype the spirit» (Bigg, 'Christian Platonists of Alexandria,' pp. 149-50). Making all allowance for fault at this point, the fact remains that «Origen was the greatest Biblical critic and exegete of the ancient church» (Terry, 'Biblical Hermeneutics,' p. 639). His one object was to find and to set forth the edifying truth in the Scripture. He said, «The passages that are true in their historical meaning are much more numerous than those which are interspersed with a purely spiritual signification.» Having adduced many passages in which a literal meaning seems impossible, he concludes, «Therefore, the exact reader must, in obedience to the Saviour's injunction to search the Scriptures, carefully ascertain in how far the literal meaning is true, and in how far impossible; and so far as he can, trace out, by means of similar statements, the meaning everywhere scattered through Scripture of that which cannot be understood in a literal signification» ('De Principiis,' IV. 1; 19). This is seen at once to be, as Davidson said, «not so absurd or injurious as many represent» ('Sacred Hermeneutics,' p. 68). Bishop Lightfoot is fully justified in saying of Origen, «A very considerable part of what is valuable in subsequent commentaries, whether ancient or modern, is due to him. A deep thinker, an accurate grammarian, a most laborious worker, and a most earnest Christian, he not only laid the foundation, but to a very great extent built up the fabric of Biblical interpretation» ('Commentary on Galatians,' p. 227). Farrar declares, «His knowledge of the Bible and his contributions to its interpretation were absolutely unrivalled» ('History of Interpretation,' p. 188). Fairweather adds, «Properly speaking, Origen was the first exegete. Everything done in this direction previously had been merely preparatory to a scientific interpretation of Scripture . . . One of the great merits of Origen is that he never shirks a difficulty. . . . Nothing could exceed his passion for verbal and grammatical accuracy, or his linguistic and critical insight, while his knowledge of the ancient theology is unique» ('Origen,' p. 120). Harnack calls Origen «the father of ecclesiastical science in the widest sense of the word,» and says that he «was an exegete who believed in the Holy Scriptures and indeed, at bottom, he viewed all theology as a methodical exegesis of Holy Writ» ('History of Dogma,' II. pp. 332, 335). In Origen, therefore, we find the founder of scientific exegesis and the great master in this field. His faults were those of his age; his excellences have been an abiding blessing to the Church. Our age is coming to agree with Gregory Thaumaturgus in his Panegyric, when he says of Origen as an exegete, «That greatest gift that man has received from God, and that noblest of all endowments, he has had bestowed upon him from heaven, that he should be an interpreter of the oracles of God to men, and that he might understand the words of God, even as if God spake them to him, and that he might recount them to men in such wise as that they may hear them with intelligence. . . . He explained whatsoever was dark or enigmatical, . . . and set it in the light, as being himself a skilled and most discerning hearer of God. . . . He alone of all men with whom I have myself been acquainted, or of whom I have heard by the report of others, has so deeply studied the oracles of God, as to be able at once to receive their meaning into his own mind, and to convey it to others. For that leader of all men, who inspires God's dear prophets, and suggests all their prophecies and their mystic and heavenly words, has honored this man as He would a friend, and has constituted him an expositor of these same oracles; the things of which He only gave a hint by others, He made matters of full instruction by this man's instrumentality; and in things which He, who is worthy of all trust, either enjoined in regal fashion, or simply enunciated, He imparted to this man the gift of investigating and unfolding and explaining them; so that, if there chanced to be any one of obtuse and incredulous mind, or one again thirsting for instruction, he might learn from this man, and in some manner be constrained to understand" (Argument, XV.) It is the picture of the perfect pattern of the union of scientific investigation and spiritual insight which makes the model exegete. The transcendent genius of Origen lifted him above his age at many points, and the twentieth century is beginning to see that his conception of revealed truth is far superior to that of most of his successors in the history of the church.

It has been customary to denounce Origen and the Alexandrian school for their indulgence in allegory and to contrast with them most favorably the next great school of exegetes at Antioch. The most distinguished names here were those of Lucian, Diodorus, Theodore, Theodoret, and Chrysostom. We are told that these men were literalists rather than allegorists. They held rigidly to the historical and grammatical sense, and it is but natural that the historical and grammatical critics of the nineteenth century should applaud their opposition to the allegorical flights of the Alexandrians. However, it is well for us to remember that this school had its dangers and faults as well as the Alexandrian. Its literalism resulted in a rationalism which was like a dry rot in the church. Historically, it led directly to Arianism, which threatened to cut the tap-root of the Christian faith; and against this the orthodox exegesis of Athanasius the Alexandrian, proved to be the only safeguard of the church at the last. Its tendency was to narrowness, rather than to richness. What it gained in straitness, it lost in breadth. However, among all the Greek fathers, Chrysostom will rank next to Origen in uniting the best characteristics of both schools. "Through a rich inward experience he lived into an understanding of the Holy Scriptures; and a prudent method of interpretation, on logical and grammatical principles, kept him in the right track in deriving the spirit from the letter of the sacred volume" (Neander, 'History of the Christian Religion and Church,' II. p. 693). Origen and Chrysostom had no worthy successors in the next millennium of church history. Jerome has been called the Origen of the Western Church, but he was too hasty in composition, too much influenced by his personal prejudice, and too vacillating and uncertain in his own opinions to deserve this name as an exegete. His services in other directions were invaluable. He was the greatest scholar in the West as Origen had been the greatest scholar in the East; but he lacked the depth of character, the consistency of principle, and the consequent spiritual intuition of that greatest master in the early church.

Augustine has exerted a wider influence upon the Christian Church than any other of the church fathers. He was the chief authority through the whole of the mediæval age. Martin Luther was an Augustinian monk at the time of his conversion; and he and Melanchthon and Calvin and Bucer all built upon the foundations which Augustine had laid down. The works of the great Latin father have been read and reverenced by Protestant and Roman Catholic alike, and it is only in our day that serious question has arisen as to his right to continued supremacy. In the present reaction from the theology of the Latin fathers to the older and purer theology of the Greek fathers, it is in the field of scholarly exegesis that the inferiority of Augustine becomes most apparent. He was not even the equal of Jerome in scholarship. He knew no Hebrew. He was very deficient in his knowledge of the Greek. He preferred a translation to the original text. He was continually making mistakes as to the meaning of words. He had all the defects of his predecessors, without their excuse for them. The Alexandrians had been driven into the use of allegory to harmonize the Gospel teaching with the truth of Greek philosophy and to command the hearing and respect of their Jewish contemporaries. But Augustine was an allegorist of the allegorists, when no necessity was laid upon him and when allegory had degenerated into mere imaginative ingenuities. Augustine had genius and a genuine Christian experience and consequently flashes of illuminative interpretation are found in his books, but these cannot compensate for the lack of the critical faculty and a sound basis of linguistic scholarship in exegesis. "Spiritual insight, though a far diviner gift than the critical faculty, will not supply its place. In this faculty Augustine was wanting, and owing to this defect, as a continuous expositor he is disappointing" (Lightfoot, 'Commentary on Galatians,' p. 233). His total influence has been an immeasurable bane to Christendom. He was chiefly responsible for subordinating exegesis to ecclesiastical authority. He said, "For my part, I should not believe the gospel except as moved by the authority of the Catholic Church" ('Ep. c. Manich.,' ch. 5. sect. 6). He declared, "Now Scripture asserts nothing but the Catholic faith" ('De Doctr. Christ.' III. ch. 10. sect. 15), and he bent his exegesis to make good that declaration. He fastened upon the Christian Church the dogmas which have been the chief hindrances to its progress for 1,400 years; "the exaggerated doctrine of total human depravity," the guilt of innocent infancy, arbitrary election involving a practical denial of the freedom of the human will, atonement by quantitative equivalence in suffering, the subtle systematization of divine counsels and schemes, the imperious necessity of sacerdotalism and sacramentarianism, intolerance of opinion contrary to churchly authority, even when based upon an earnest and intelligent study of the revealed Word. Following his lead the Church has floundered for centuries through sloughs of despond and has almost forgotten the broader horizon and the fresher air of the high table-lands of the earlier theology. Among the Greek fathers no one of these questions which have afflicted our Latinized christianity found an atmosphere congenial enough in which to thrive. We owe much to Augustine, but it is hard for us to believe that his good influence can begin to equal his evil influence upon the Christian Church. His is the last great name among the church fathers. For a thousand years little or no progress was made in the interpretation of the Scriptures.

The Schoolmen contented themselves for the most part with copying and compiling the work of their predecessors in this field. It became a proverb among them, Si Augustinus adest sufficit ipse tibi. One of them stated plainly that no interpretation of Scripture must be accepted which ran counter to the authority of the Church, «however much such a sense may be in conformity with the literal meaning. Indeed that ought not to be called the literal sense which is repugnant to ecclesiastical authority» (Paulus of Burgos, 'Prol. in Additiones'). Even Gerson declares, «The literal sense must be judged according as the Church has determined» (Propp. de sens. lit. 3). With no independence of thought and with no fresh scholarship the schoolmen added no new principle of exegesis in a thousand years of commentary writing. They were expending their energies upon subtle and futile speculations. They composed great folios which aimed at nothing original and arrived nowhere in particular. They labored hard in a treadmill. They were weakest in exegesis. Only two or three of them knew any Hebrew, and the most of them knew very little if any Greek. They were unoriginal, uncourageous, uncertain, uninformed. They had a wrong notion of the Church and a wrong conception of inspiration, and it naturally followed that they had a wrong method of exegesis. They had their merits too, but not as exegetes.

With the Protestant Reformation we come to a new era in Scriptural exegesis. Coleridge said of the Reformers, «The least of them was not inferior to Augustine and worth a brigade of Cyprians, Firmilians, and the like» ('Remains,' III. p. 276). Calvin sweepingly asserts, «Modesty will not allow me to speak of ourselves as fact would justify; and yet I will most truly declare that we have thrown more light upon the Scriptures than all the doctors who have appeared under the Papacy since its commencement. This praise even they themselves dare not deny us» ('Antid. in Conc. Trid.,' Sess. IV). The Bible seemed like a fresh discovery to the Church of that day. For the first time it became the property of the common people; and the printing press made it possible for it to become a common possession. It had been locked up in the Latin tongue and was supposed to be the peculiar property of the priests. Translations now made it accessible to all and the Protestant preachers constantly appealed to its authority in their opposition to the usurpations and the abuses of the hierarchy. That necessitated a renewed study of the sacred text on both sides. It soon became impossible for a man to be a doctor of divinity for eight years, as Carolstadt confessed that he had been, before he had read his New Testament. The Protestants delighted to circulate such stories as that of Sixtus of Amana concerning Albert, archbishop of Mayence, who read a few pages in the New Testament and then put it down, saying, «I know not what book this is, I only see that all things contained in it are hostile to us» ('Antibarb. Bibl.' II. 7). The churchmen and schoolmen had always based their doctrinal systems upon the Bible, but the stereotyped interpretation of the Scriptures had come to claim the authority of the Scriptures themselves. John Nathin said to Martin Luther in the convent at Erfurt, «Brother Martin, let the Bible alone; read the old teachers: they give you the whole marrow of the Bible; reading the Bible simply breeds unrest» (Lindsay, 'History of the Reformation in Germany,' p. 200). Heresbach, the friend of Erasmus, heard it said that the study of the original Greek was the prolific source of all heresies, while the study of Hebrew turned men into Jews at once. (D'Aubigne, I. ch. 3). It was deemed dangerous for the layman to attempt to understand the Scripture for himself; it was his duty to accept the interpretation of the book by the Church. It was at this point that the protest was made; and all the Reformers insisted that the Bible ought to be open to every man and that the Spirit of God would help every man to a safe and sufficient understanding of its contents. Luther came to take the position that no external authority could decide what was Scripture or what was the meaning of Scripture. He said, «How can we know what is God's Word and what is true or false? . . . . Who decides me there? No man, but only the truth which is so perfectly certain that nobody can deny it» (Dods, 'The Bible, Its Origin and Nature,' pp. 38-40). Calvin said, «Scripture is self-authenticated, carrying with it its own evidence. . . . It obtains the credit which it deserves with us by the testimony of the Spirit» ('Institutio.' I. 7; 5). Over against this position may be put the words of Lacordaire, «What kind of a religion is that which saves men by aid of a book? God has given the book, but He has not guaranteed your private interpretation of it. . . If there be a true religion on earth, it must be of the most serene and unmistakable authority» (cf. Lindsay. op. cit., p. 457). That authority is not, according to Lacordaire, found in private judgment but in the infallible decree of Pope or Councils. Such was the issue drawn by the Reformation, both parties claiming the authority of the Scriptures, the one as interpreted by the Church for all, and the other as interpreted by the Spirit to each man. It was equally incumbent upon all concerned to show that their interpretation was the true one. This battle over the Book led to such searching of the Scriptures as had not been seen in the Church in any period of its history.

The way was opened for an intelligent discussion of the Scripture text largely by the labors of Erasmus of Rotterdam. His edition of the Greek Testament became the standard text among the reformers. His translations.

annotations, and paraphrases entitle him to high rank as an exegete. He was independent in judgment, characterized by good sense, and a philologist without a peer. His aim was to make the meaning of the Word perfectly clear to all. He said, "I do not see why the unlearned are to be kept away, especially from the evangelical writings, which were proclaimed alike to learned and unlearned, equally to Greeks and Scythians, as much for slaves as for the free, at the same time to men and to women, not less to peasants than to kings" ('Praef. in Paraph. in Matt.'). Erasmus still clung to the mystical or allegorical interpretation of certain Scriptures and thought that the Holy Spirit had intended that some words should carry multiple meanings. It was Martin Luther who broke finally and conclusively with this ancient error. He deserves highest honor as an exegete as well as a reformer by the enunciation of this principle, "Each passage has one clear, definite, and true sense of its own. All others are but doubtful and uncertain opinions." He added, "The literal sense of Scripture alone is the whole essence of faith and of Christian theology. . . . Allegories are empty speculations. . . . An interpreter must as much as possible avoid allegory that he may not wander into idle dreams. . . . To allegorize is to juggle with Scripture. . . . If we wish to handle Scripture aright, our one effort will be to attain *unum, simplicem, germanum, et certum sensum literalem*" ('Commentary on Genesis'). Unlike Jerome and so many others who had recognized these truths before him, he is true to these principles in his own exegesis. He published 'Notes' on many portions of the Scripture, and a complete 'Commentary on Galatians.' His exegetical works were published in a score or more of volumes in both Latin and German, and were of paramount influence in introducing better methods of exegesis in the Reformed churches. Melanchthon, Bucer, Zwingli, Beza, and many others did notable work in exegesis in the Reformation period; but their books are for the most part unread to-day. The greatest exegete among the reformers was John Calvin. He wrote complete commentaries on nearly the whole of the Bible. The single exception in the New Testament was the book of the Apocalypse; and Judges, Ruth, Kings, Esther, Ezra, Nehemiah, Proverbs, Ecclesiastes, and Song of Solomon were the only books left untouched in the Old Testament. His commentary on the Psalms was justly celebrated for its religious insight; and in the Pauline epistles and the book of Acts he is at his best in the New Testament. He wrote to his friend Grynæus in 1539, "We were both of this mind, that the principal point of an interpreter did consist in a plain briefness. . . . We wished that there might be some one who gave his diligence not to trouble those who are desirous of learning with long commentaries" ('Praef. in Rom.'). This suggests one chief excellence of Calvin's exegetical work. It is clear and concise and not loaded down with references to a host of other authorities. Calvin has the learning necessary for his task, but he makes no needless display of it. He uses it simply to present plainly the meaning of the text. He was honest and independent in his comment, intelligent in his method, and comparatively free from the worst faults of all his predecessors in this line. He never agreed with Luther as to the adequacy of the private judgment; and yet he was a persecutor of those who did not agree with his own views. The prejudices of his peculiar theology appear throughout his commentaries, and the repudiation of his conception of the decree as the central idea of Christianity has gone far to detract from his use and usefulness in the America of the 20th century. However he is still worth consulting for his good sense in most things and his good style in all.

It seemed a necessity of the age that all Christians should be dogmatists, and Protestant dogmatism soon became as deadly an influence in the field of exegesis as Roman Catholic tradition had ever been. The successors of the great Reformers were like the schoolmen who succeeded the great Fathers of the early Church. They were subservient to authority and fettered by dogma; and in the 17th and 18th centuries very few exegetes appeared whose works are read to-day. The scholarship of the elder Lightfoot is valued. The practical comments of Robert Leighton on First Peter are still enjoyed. John Owen's Exercitations on the Epistle to the Hebrews is a monument of erudition and pious reflection; but, like Caryl on Job, it is too voluminous to hold attention in this modern age. Robert Hall said of Owen, "He always takes for granted what he ought to prove, while he is always proving what he ought to take for granted; and after a long digression, he concludes very properly with, This is not our concernment; and returns to enter upon something still farther from the point." Adam Clarke added, "To me he is one of the most unsatisfactory of writers. His sense and meaning he drowns in a world of words. He cannot condense his meaning, and never comes to the point, but by the most intolerable circumlocution" (Etheridge, 'Life of Adam Clarke,' pp. 317-18). He may stand as probably the last example the world will ever see of such intolerable prolixity. Arminius and Grotius introduced the reaction from Calvinistic and Lutheran and Augustinian exegesis, which has been gathering force ever since and which has about come to its triumph in America. Cocceius and Vitringa in their opposition to scholasticism and dogmatical bias furnished a series of commentaries with many excellent qualities, but reverting too far in the direction of the mystical or allegorical interpretation. Bengel's Gnomon is a model of brevity and learning in exegesis. Philip Schaff calls it "a marvel of *multum in parvo.*" Henry, Scott, and Adam Clarke wrote devotional commentaries which are still in use. Ernesti has been regarded as the founder of a new exegetical school, attempting to hold the *via media* between the allegorists and the dogmatists. His exegesis was predominantly grammatical. Semler, pietist and rationalist, introduced the historic method of exegesis, and prepared the way for the unparalleled exegetical activity of the 19th century. The most dominant influence in the 19th century in the whole field of theology was that of Schleiermacher. He was the founder of what has been called the psychological school of exegesis. He was both rationalistic and supernaturalistic in his interpretation of the Scriptures. He appealed to opposing classes and did much to bring all Germany back to a central emphasis upon the person and teaching and influence of Christ. In Germany and, through Coleridge and Maurice, in England and America his spirit and methods have been fruitful of much good in Biblical study. "Church history offers no parallel to him since the days of Origen" (Farrar, 'History of Free Thought,' p. 244). "He was the Plato and Origen of Germany in the 19th century" (Philip Schaff). He based his religion upon faith and feeling, and he made the Christian consciousness and personal experience the guiding lights of his Scriptural interpretation. He claimed a Divine compulsion in his teaching and spoke and wrote with prophetic fervor and authority. He said, "Divinely swayed by an irresistible necessity within me, I feel myself compelled to speak. . . Nor is it done from any caprice or accident. Rather . . . it is a divine call" ('Reden über die Religion,' I). His personal magnetism and pronounced genius, his eloquence and earnestness, the genuineness of his Christian experience, the remarkable breadth of his vision and thought, and the intensity of his spiritual zeal gave him a most extraordinary influence upon his own and succeeding generations. He vindicated the right of Christian experience to an equal hearing with the results of any purely scientific research. His spirit pervades the Christian world to-day and will maintain its permanent place in Christian thought. De Wette was the greatest exegete among the disciples of Schleiermacher. His work represents prodigious learning and "perfect loyalty in the search for truth" (Godet). He expresses himself clearly, but does not always come to a desirably definite conclusion. Credner occupied practically the same standpoint.

The year 1835 marked a new era in all scientific Bible study (Pfleiderer, 'Development of Theology,' p. 209). In that year Strauss published his 'Life of Jesus,' Baur, his work on the 'Pastoral Epistles,' and Vatke his 'History of the Religion of the Old Testament.' Each of these books may be regarded as epoch-making.

Eichhorn had reduced the rationalistic treatment of the Scriptures to a scientific system. Strauss was the first to put this rationalism into concrete and popular form. Baur was the founder of the Tübingen or Tendency school, which probably represented in Germany the greatest theological movement of the century. Baur endeavored to bring all his exegesis to the bar of historical investigation. He examined all traditional exegesis critically and subjected the New Testament books to a more thoroughgoing analysis than they had ever known. He emphasized the theological standpoint of each writer, and he thought he detected an irreconcilable antagonism between the Pauline and the Petrine wings of the Christian Church. He stimulated Bible study to an astonishing degree. His personal power was manifest in the remarkable group of disciples he gathered about him. Among these we may mention Zeller, Schwegler, Hilgenfeld, Holsten, Pfleiderer, and Volkmar. The entire movement inaugurated by Baur has been characterized by comprehensive and accurate scholarship, the value of which has been somewhat impaired by the critical presuppositions upon which it was based. Strauss came over into this school in the second edition of his 'Life of Jesus.' Ritschl began his career in it, but later swung clear of it and became the founder of a distinct school of thought, to which Harnack, Jülicher, Kaftan, Hermann, and Von Soden adhere.

Ritschl claimed to repudiate all metaphysical presuppositions and to found his system on the religious consciousness alone. He believed that the primitive faith sprang from the person and word of Jesus, with no philosophical alloy in the beginning. He held that experience limits the domain of knowledge. The Scriptures are sufficient in themselves to reveal the spiritual and moral worth of the kingdom of God, whose end is realized in love. Dogmatics and ethics unite in the higher synthesis of the revelation of the New Testament. Frank was the most determined opponent of Ritschlianism in Germany. He pointed out the lack of a true and deep conception of sin in this system of thought, and its consequently inadequate notion of atonement and conversion; and he claimed that, instead of rejecting metaphysics, the whole system was based on a highly developed but false and contradictory metaphysics of its own.

Vatke in 1835 outlined the revolution which has since taken place in the conception of Old Testament history. His book, however, was overloaded with philosophical terminology and met with no general appreciation and soon seemed to be forgotten. Reuss lectured along the same lines at Strassburg; and two of his pupils, Graf and Wellhausen, published the new hypothesis of the development of Old Testament ritual and literature. It was Vatke's theory brought to life again, and it has exercised increasing influence upon the exegesis of all the Old Testament books for the last half century. The prophets have come into new prominence as a result of this study. They are recognized as the founders of the Hebrew religion. The Law in its present form was of later growth in the Jewish Church. The Pentateuch has been resolved into a number of documents. Deuteronomy is believed to belong to the times of Josiah. Isaiah and other prophetic books are shown to be of multiple authorship. The Psalms come last in the Hebrew sacred literature. Stade, Budde, Smend, Schultz and others have represented this school of thought.

Germany has been the great battle-ground of the Higher Criticism through the last century; and the exegetes have enrolled themselves among the critical and the traditional, the more radical and the more conservative camps. Neander the champion of spirituality, Hengstenberg the bulwark of orthodoxy, Delitzsch the pre-eminent scholar did valiant service for what they deemed the traditional truth. Just before his death Delitzsch seemed disposed to go over into the critical ranks. Dillmann and Gunkel have adopted the newer views. The indispensable commentary in the New Testament field has been that of H. A. W. Meyer. Characterized by grammatical rigor and literary freedom, and brought up to date by frequent revisions, it has maintained itself as a standard authority for two generations. The principal contributor to the later editions has been Bernard Weiss, the present prince of all laborers in the exegetical field. Having completed more than 50 years of University service he stands to-day without a peer in his record of worthy achievement as a textual critic and commentator. He is incomparable for minute and searching investigation, exactness and solidity of scholarship. His associates in the Meyer Commentary series have been Wendt, Heinrici, Sieffert, Schmidt, Düsterdieck, and Beyschlag. Lipsius, Weizsäcker, Schmiedel, and Holtzmann have represented the more advanced school of commentators. Bleek did most admirable work in the earlier part of the century; and Luthardt and Hofmann have been conservative leaders in the later days.

Among the Dutch theologians the dominant tendency in the last century has been toward extreme radicalism. Scholten and Kuenen have represented advanced thought in the Old Testament field, while Loman, Pierson, Naber, Völter, and Van Manen have been generally considered hypercritical in the discussion of New Testament questions. Steck has represented the latter school in Switzerland; while Godet has nobly upheld the traditions of orthodoxy in this land. Godet combines a French felicity of style with a German thoroughness of scholarship and adds to these a genuine spiritual fervor which makes his commentaries on Luke, John, and Romans veritable masterpieces of exegesis. It may well be doubted if the century has produced more luminous and interesting contributions to this field.

France has furnished the brilliant and versatile and radical Renan, and the more profound and philosophical De Pressense; and it is making its influence felt to-day through the writings of the new Symbolo-Fideistic school, Stapfer, Sabatier, and Ménégoz being the chief theological representatives. This school emphatically repudiates the infallibility of Pope or Church and just as emphatically renounces the infallibility of Scripture or the Christ recorded in Scripture. It believes that philosophy can never deduce any religious truth from its premises, and so repudiates rationalism as a foundation for faith. It believes in a Divine revelation through the immanent Spirit of God. It identifies prayer and religion. All expression of religious impression must be through images or symbols. «All religious formulas are symbolic formulas; and Dogmatic itself is a great system of symbols» (Ménégoz). The essence of the gospel is to be distinguished from what is merely contingent. Jesus is the perfect manifestation of God in man. Salvation is by faith and faith consists in repentance and heart-surrender to God. The advocates of this school confidently claim that the future belongs to them.

In Great Britain the century has furnished some masterly exegetical work. Cambridge University has easily taken the honors in this field. Dean Alford in his ‹Commentary on the Greek Testament› introduced the best results of German exegesis to English readers. Bishop Ellicott gave splendid examples of painstaking investigation of the Scriptural text. The great trio of later Cambridge scholars, Lightfoot, Westcott, and Hort have reached the highwater mark of English scholarship in their field. Bishop Lightfoot's commentaries upon the Pauline Epistles have been standard authorities ever since their publication. Westcott did equally fine work upon the writings of John and the Epistle to the Hebrews. Hort was generally reputed to be the greatest scholar of the three, but his extreme modesty and his realizing sense of the yet unattained perfection possible in his work kept him from the publication of any but fragmentary treatises. His influence lives among his students and associates. Mayor on James and Swete on Mark are worthy companions of the other Cambridge University commentaries. Prof. Davidson of Edinburgh was the leading Hebrew scholar of Great Britain in the century, and his pupils, W. Robertson Smith and George Adam Smith and others, have done yeoman service in revolutionizing and revitalizing the exegesis of the Old Testament. Sanday, Driver, Plummer, Beet, Findlay, Bruce, and Dods have done excellent interpretative work. The ‹International Critical Commentary› and the ‹Expositor's Greek Testament,› now in process of publication, bid fair to continue the best traditions in English exegesis.

America has had a share in the exegetical labor of the century. Moses Stuart, J. A. Alexander, Hackett, Hodge, Shedd, Harper, Mitchell, Moore, Toy, Vincent, and others have produced exegetical studies of acknowledged merit. Albert Barnes, Henry Cowles, J. A. Broadus, and D. D. Whedon have published series of helpful and devotional commentaries. Ezra Abbot, Edward Robinson, McGiffert, Mathews, Burton, Briggs, Bacon, Gilbert, Stevens, Allen, and Smyth have done first-class service in special fields.

The Roman Catholic Church began the century with two most worthy representatives of Biblical learning. Hug ably combated the rationalistic tendencies of his day and defended the traditional views of the origin of the New Testament writings. Herbst performed the same service for the Old Testament. During the greater part of the century, however, free inquiry has been more or less stifled by the authority of «the usual exegesis of Scripture.» Scientific research has been systematically discouraged and any tendency toward a new or modified interpretation of the Scriptural text and any originality of conclusions, such as may not be guaranteed by the authority of the Fathers and the Councils of the Church, have been frowned upon by those in the places of power. A better condition of affairs seems to be on the point of realization now. A growing body of students within the pale of the Church have felt the influence of the great onward movements in the Protestant world and are beginning to demand the privilege of free inquiry and the use of modern methods in exegesis. They point to the critical work in the writings of Origen and Jerome and Eusebius and other Christian scholars and saints as proof that scientific research is no novelty in the Catholic Church, and they claim the right to follow in the footsteps of these illustrious critics of antiquity. A measure of freedom would seem to be already granted them since Pope Pius X. has written to Bishop Le Camus, «We should not approve the attitude of those who in no way dare to depart from the usual exegesis of Scripture, even when, faith not being at stake, the real advancement of learning requires such departure. You follow a wise middle course, and by your example show that there is nothing to be feared for the sacred books from the true progress of the art of criticism, nay that a beneficial light may be derived from it, provided its use be coupled with a wise and prudent discernment» (Dated Jan. 11, 1906). What this «wise and prudent discernment» may be is probably best illustrated in the decisions of the Biblical Commission appointed by Leo XIII., in its report upon the Pentateuch, published in the *Revue Biblique* and dated June 27, 1906. The report is presented in the form of questions and answers in catechism style. They may be summarized as follows: May one assert that Moses was not the author of the Pentateuch, but that it was made up largely of later elements? No. Must Moses then have written the whole of the Pentateuch with his own hand, or dictated it to secretaries? No. May Moses have committed the editing of it in whole or in part to secretaries and have permitted the publication of it under his name? Yes. May he have used sources, documents or oral traditions, borrowing sometimes the words, sometimes the sense? Yes. May the Pentateuch have undergone modifications, «additions made after Moses' death by an inspired author, glosses and parenthetical explanations, ancient words and phrases turned into more modern language, false readings to be attributed to errors of copyists, which criticism may examine and weigh according to its principles? Yes, the Church reserving judgment.» The rights of the newer criticism to a hearing and standing in the Church are clearly allowed in this report, while the Church reserves the right to judge to what extent the findings of the critics may be compatible with its authority and peace.

Historical criticism has now come to the fore. The allegorical interpretation is discredited, it is to be hoped, finally and permanently. A vaster knowledge is at the service of the exegete than has been possible in any preceding age. The battles of the giants would seem to have ended for the time at least, and much of the smoke of conflict has cleared away. What ought the twentieth century exegesis to be? It ought to be capable of the production of both popular and critical work. It ought to meet the demand for edification on the part of the most humble and unlearned; and at the same time it ought to be proficient in the most exhaustive scholarship. It has at its disposal the accumulated wealth of material collected in the preceding centuries; and it may profit by the defects as well as the excellences of the masters who have gone before. Biblical knowledge was never more profound or more prevalent than now. The original text has been determined within approximate accuracy. The Bible has been freed from multiplied errors of manuscript transcription and restored to something like its original form and revelation. The original languages are better understood. The study of ancient inscriptions and fragments of newly discovered papyri have thrown a flood of light upon many new points. Modern travel and exploration and excavation in the Orient have taught us many things concerning the manners and customs of the ancient times. The marvellous advance made in the last century along the lines of scientific investigation and metaphysical research and literary criticism has had its beneficial influence upon the interpretation of the Bible. The exegete of to-day has an unprecedented equipment, and his task is comparatively clear. To-day, «the great body of evangelical expositors are united on the fundamental principles of interpretation. They agree that a proper commentary on the Bible or on any part of it, should clearly set forth the true meaning of the words and the train of thought intended by the sacred writer; and it should point out the grammatico-historical sense of every passage, giving careful attention to the context, scope, and plan» (Terry, ‘Biblical Hermeneutics,’ p. 738). The great exegetical works of the present are characterized by directness, accuracy, learning, independence of research, a careful consideration of the context and all the light that historical and literary criticism can throw upon the theme. There is a better conception of the nature of inspiration and more freedom in the exercise of the critical faculties of the commentator. Rationalism has come to its rights, together with a recognition of the due restraint laid upon the student of a divine revelation. Having escaped from the tradition of an absolutely inerrant text and a form of revelation infallibly fixed for all time, the exegete of to-day is freer to turn from the letter that killeth to the spirit that maketh alive. The tendency of the times seems to be away from the dominance of the Latin and the Reformation theology to the purer exegesis of the primitive faith. With the broader spirit of the Greek fathers and the better critical apparatus of the present day the promise of work in this field was never brighter than now.

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Exelmans, ĕks-ĕl-mŏng, **Remy Joseph Isidore,** Comte; French soldier, Marshal of France: b. Bar-le-duc, 13 Nov. 1775; d. 22 July 1852. He entered the army in 1791, when only 16 years of age, and by 1799 had reached the rank of captain. He subsequently served with great distinction under Macdonald and Championnet in the campaign of Naples, and in 1801 was appointed to the staff of Murat as aide-de-camp. He was arrested in 1808 while serving with Murat in Spain, and sent to England, but after three years of confinement there effected his escape and in 1812 joined Napoleon in his Russian campaign. For brilliant conduct during this campaign he was appointed general of division by Napoleon but upon the Emperor's fall was banished from France owing to his Napoleonic inclinations. He was, however, permitted to return in 1819 and seems to have been highly esteemed under every successive government. He was restored to the Chamber of Peers in 1831 by Louis Philippe and Louis Napoleon appointed him grand chancellor of the Legion of Honor, and on 11 March 1851 created him Maréchal de France. He was subsequently thrown from his horse which resulted in his death.

Exercise, Physical. The upbuilding of the muscular system of the body is of prime importance in preserving the health or the curing of disease, and whether by passive motion or volitional activity is now recognized as necessary to keep the various functions of the body in normal condition. Artificially devised methods have been brought into use but regular daily out-of-doors exercise is preferable. Instruction in gymnastics is now given in many educational institutions and public schools, well-appointed gymnasiums being maintained for that purpose. In these gymnasiums outdoor sports are often practised, but the chief courses of exercise consist of a systematic use of dumb-bells, wands, Indian clubs, horizontal and parallel bars, chest-weights, swinging rings and other specialties. In many gymnasiums there are running tracks, baseball cages, swimming tanks, bowling alleys, etc. The chief outside sports are tennis, golfing, bicycling, baseball, football, rowing, walking, running, skating, swimming, and the various forms of track athletics. See GYMNASIUM, HISTORY OF; HYGIENE; PHYSICAL TRAINING; EDUCATIONAL ATHLETICS; etc.

Exercises, Spiritual. See SPIRITUAL EXERCISES.

Exeter, England, a city, seaport, and county, parliamentary and municipal borough, in the county of Devon, on the left bank of the Exe, 10 miles northwest from its outlet in the English Channel, on the Great Western and London and Southwestern railways. Though still presenting many indications of antiquity, the city can now boast of as handsome squares, terraces, streets, and houses, all of modern erection, as any other in the kingdom. The principal object of interest is the cathedral, a noble edifice of high antiquity. It is cruciform, 408 feet in length, and consists of a nave, with two side aisles; two short transepts formed out of two heavy Norman towers, each 130 feet in height; a choir of the same width as the nave, and 128 feet in length; 10 chapels or oratories, and a chapter-house. The west front is richly decorated, presenting one of the most picturesque façades of any building in Europe. The interior, now restored by Sir G. Gilbert Scott, is magnificent. Other architectural antiquities are the remains of the castle of Rougemont, portions of the ancient city walls of Athelstan, Norman work in some of the churches, and the noble guild-hall, tastefully restored. Among several fine modern churches Saint Michael's may be mentioned. Among the numerous educational establishments is the Exeter school, founded by the citizens in the time of Charles I., to which there are a number of free scholarships. It has 16 exhibitions to either of the Universities of Oxford or Cambridge. The Exeter Diocesan Training College is also situated in the city. The charitable institutions of various kinds are numerous. They comprise the Devon and Exeter Hospital, many almshouses, a dispensary, a lunatic asylum, a deaf and dumb institution, a penitentiary, an eye infirmary, a lying-in charity, a humane society, a stranger's friend society, etc. The principal scientific and literary institutions are the Devon and Exeter Institution for the Promotion of Science, Literature, and Arts, established in 1817, and possessing a valuable library; the Exeter Literary Society, established in 1835; and the Royal Albert Memorial College, Museum, and Free Library, whose enlarged buildings were opened in 1899. The college has over 1,000 students. Exeter is not an industrial town, its woolen manufacture, once one of the largest in England, being extinct; but it has iron-foundries, manufactories of agricultural implements, paper-mills, corn-mills, tanneries, etc. Glove-making and lace-making are also carried on. By means of a canal, 5 miles in length and 15 feet in depth, vessels of 400 tons can reach the city, and there is a large floating basin. The Exe itself is not navigable to the city. Exeter is a place of remote antiquity, having been a British settlement long prior to the invasion of the Romans, by whom it was called *Isca Damnoniorum.*

Exeter, N. H., town, one of the county-seats of Rockingham County; on the Squamscott River, the Boston & M. R.R.; 26 miles east of Manchester, and about 13 miles southwest of Portsmouth. Exeter was founded in 1638 by John Wheelwright, a Congregationalist clergyman, who was banished from Massachusetts. Massachusetts claimed control over the place until 1680. It was the capital of New Hampshire, and the centre of military movements of the colony during the Revolution. The town is well known as the seat of the Phillips Exeter Academy (q.v.), established in 1781. The Robinson Female Academy is located in Exeter. The town contains a large public library and a number of manufacturing establishments: a large shoe factory, cotton-mills, iron, brass, and machinery factories. Pop. (1910) 4,807. Consult: Fassett, 'Colonial Life in New Hampshire'; Bell, 'History of the Town of Exeter.'

Exeter Book, or **Codex Exoniensis,** a unique manuscript of Anglo-Saxon poetry in the library of Exeter cathedral. It was presented to the chapter by Leofric, first bishop of Exeter (1050–72), contains 246 pages of vellum, and is the extant original copy of some valuable remains of Anglo-Saxon literature. The text with a translation is to be found in Gollanez, 'The Exeter Book' (1895).

Exeter College, Oxford. This college, originally called Stapledon Hall, was founded by Walter de Stapledon, bishop of Exeter, sometime lord high treasurer of England, who removed to this place his scholars from Hart Hall, and made a foundation for a rector and 12 fellows. In 1404 Edmund Stafford, bishop of Exeter, added two fellowships and obtained leave to give the college its present name. In 1565 Sir William Petre, secretary of state, added eight; in 1636 Charles I. annexed one for the Channel Islands, and lastly, Mrs. Shiers left certain rents in 1770, out of which two fellowships were founded. Under the authority of 17 and 18 Vict., cap. lxxxi., the fellowships (a number of which were appropriated to various archdeaconries or counties) were reduced from 25 to 15, and were thrown open; they are now 12 in number. From the revenues of suppressed fellowships over 20 scholarships were founded, eight of which (called Stapledon scholarships) are limited to persons born or educated in the diocese of Exeter, and one or more to persons born in any of the Channel Islands, or educated at Victoria College, Jersey, or Elizabeth College, Guernsey.

Exeter Hall, a large building on the north side of the Strand, London, opened in 1831. It is capable of containing over 3,000 persons. In it the «May Meetings» of the several religious societies are held. It is now the property of the Young Men's Christian Association.

Exhaus'tions, Method of. The ancient geometricians employed the method of exhaustion for determining the areas of curves, and for the solution of similar problems. The method consists in comparing the magnitude to be determined with rectilinear magnitudes; thus, the area of a curve with the area of a polygon constructed so as to be comparable with the curve in question. The use of the method is exemplified in the second proposition of 'Euclid's Twelfth Book.' The method was applied with all the rigorous logical exactness for which the Greek geometricians are so famous. See Geometry; Mathematics.

Exhibi'tion, an endowment or benefaction. See Endowment.

Exhibition, Industrial. The promotion of trade and manufactures by means of collections of works of industry and art has no claim to the merit of novelty. In modern times, however, the idea has been more systematically carried out, and was probably suggested by the good effects produced by two institutions of a like nature — the galleries of rare productions of art or nature collected by the wealthy and educated, and the exposure for sale of ornamental and useful articles in the stores of individuals, and more particularly on a large scale at the great fairs which in former times were more important features of commercial enterprise than they now are. The beneficial effect thus derived from the exhibition and comparison of the manufactured products of different localities could not long escape notice. In England this knowledge was brought to practical purposes in the 18th century, when the Society of Arts in 1756–7 not only offered prizes for specimens of manufactures, but exhibited the works of the competitors. In France an exhibition embracing all kinds of manufactures was held in the year 1798, and another under the consulate of Bonaparte in 1802, and the gratifying results attained led to the idea of holding them every three years, which was carried out as far as the political troubles of the country would allow. Many exhibitions were subsequently held at different cities on the continent of Europe, and in the British Islands exhibitions of a more or less local nature were held in Dublin, Manchester, Liverpool, and Birmingham, as well as in London in the premises of the Society of Arts. All these had been generally successful, but the necessity of having an exhibition on an international scale had become with some a fixed idea. This was first brought fairly before the British public in 1848 by Prince Albert, then president of the Society of Arts. In 1849 the project for an exhibition in which all nations might join began to take a tangible shape; and it was at last determined by government to issue a royal commission to deal with the matter, which was gazetted 3 Jan. 1850. The better to enable the commissioners to enter into contracts and otherwise incur obligations, subscriptions were procured to a guarantee fund, the queen leading the list with $5,000. A vast structure of iron and glass, generally designated the Crystal Palace, built from the design of Joseph Paxton, was erected in an incredibly short space of time in Hyde Park, London, and was opened by Her Majesty on 1 May 1851. The extreme length of the building was 1,851 feet, the width 408, and the height about 64 feet. The entire area was about 19 acres. In the ground floor and galleries there were about eight miles of tables set apart for the exhibitors. The articles sent for exhibition were divided into four great sections: Raw materials, machinery, manufactures, and fine arts. The number of exhibitors was about 15,000. The exhibition remained open until 11 October, and the number of visitors during the 144 days amounted to about 6,170,000. After all expenses were defrayed there was a balance of $700,000 left. The immense success of the undertaking encouraged the local and national exhibitions of Dublin and New York in 1853 and of Munich in 1854; and the French nation in 1855 opened its first Exposition Universelle. The main building was an imposing structure of white stone and of classic architecture. The buildings were erected in the Champs Elysées, and covered about 24 acres. There were in all about 24,000 exhibitors, and the contents were pronounced greatly in advance of those exhibited in London in 1851. It was said that continental manufacturers had taken lessons from the British exhibition which the British had failed in fully profiting by, and so exhibited a vast improvement in works in which the latter considered themselves unrivaled. This was followed by the national exhibitions of the Dutch at Haarlem and the Belgians at Brussels, both in 1861, and the following year by the second great international exhibition held in London. It occupied a vast brick building, lighted by a roof and two immense cupolas of glass, and erected in the garden of the Horticultural Society at South Kensington. The space covered was about 17 acres. There were 26,348 exhibitors in the industrial division, of whom 8,487 were British, and in the fine art division 2,305, of whom 990 were British. The aggregate number of visitors from 1 May to 31 October was 6,211,103, giving an average of 36,328 per day. The productions, which came from almost all parts of the globe, were divided into 40 classes, and included manufactures of all kinds — machinery, chemical products, railway plant, and ordinary vehicles, animal and vegetable products used in food or manufacture, architecture, painting, sculpture, engraving, etc. This exhibition was also eminently successful, and enabled the public to judge of the progress or shortcomings of British home manufactures and art as compared with others. In 1865 a rather important exhibition was held in Dublin which was a pecuniary failure. The second French International Exhibition was opened on 1 April 1867, and closed on 3 November. On 1 May 1871 the first of the British annual international exhibitions of fine arts and industry was opened by the Prince of Wales. On 1 May 1873 the first Austrian international exhibition was opened by the Emperor Franz Josef with great pomp and ceremony. The building was situated in the Prater, or, as it may be called, the park of Vienna, and was 2,940 feet in length, with an average breadth of 570 feet. A great exhibition was opened by President Grant at Fairmount Park, Philadelphia, upon the occasion of the centennial festival of the American declaration of independence. It occupied 60 acres, and had nearly 10,000,000 visitors. A third French International Exhibition was held at Paris in 1878; area occupied 140 acres; visitors 17,000,000. A fourth French International Exhibition was opened by President Carnot in 1889 to commemorate the centenary of the Revolution, the visitors to which numbered over 25,000,000. One of its chief features was the Eiffel tower, of iron, 984 feet high. The series of exhibitions which were held at South Kensington, London, included The Fisheries (1883), The Health (1884), The Inventions (1885), and the Exhibition of Colonial and Indian products (1886); the latter of which was visited by 5,550,749 visitors. Besides these, exhibitions have been held in Edinburgh (1886), at which there were 2,769,632 visitors; Manchester (1887) at which there were 4,765,000 visitors; and Glasgow (1888), with 5,748,379 visitors. In 1899–1900 a huge International Exhibition was held at Paris, but, though visited by about 47,000,000 persons, was not a financial success. It occupied the Champ de Mars and extensive areas on both sides of the Seine.

In 1893 the fourth centenary of the discovery of America by Columbus was celebrated by the World's Columbian Exposition, at Chicago. It excelled all predecessors in conception, scope, and grandeur. Every nationality contributed to the exhibits, and many countries possessed their own buildings. The «White City,» as it was called, was opened by President Cleveland, 1 May and closed 30 October. It occupied about 600 acres, at Jackson Park, on the shore of Lake Michigan, including the «Midway Plaisance.» Nearly every State in the Union was represented by its own edifice. The principal buildings were Machinery Hall, the Art Palace, and those devoted to transportation, mining, electricity, agriculture, manufacture and liberal arts (covering 44 acres), government, administration, fisheries, horticulture, and anthropology. The total admissions for the period named were 27,539,521, and the receipts from this source $10,317,814. The largest attendance on any one day — Chicago day, 9 October — was 716,881. Other notable exhibitions in the United States were the California Mid-Winter Exhibition, held in San Francisco in 1894; the Cotton States and Industrial Exposition held in Atlanta, Ga., September to December, 1895; the Tennessee Centennial Exposition, held in Nashville, Tenn., 1 May to 31 Oct. 1897; the Trans-Mississippi Exposition in Omaha, Neb., 1 June to 1 Nov. 1898; the Pan-American Exposition, in Buffalo, N. Y., from 1 May to 2 Nov. 1901; the South Carolina Inter-State and West Indian Exposition, held in Charleston, from 1 Dec. 1901 to 1 June 1902, and the World's Fair at St. Louis, Mo., in 1904, in celebration of the Louisiana Purchase, its projectors claiming for it «the greatest exposition in all history. The buildings in Forest Park to the number of 15 great structures stand in a tract of 1,180 acres, and the total amount of money expended exceeds $15,000,000. A feature of the exhibition was 250 original groups of sculpture containing 1,650 figures. The exhibition included an air-ship contest, a fashionable horse show, a live stock show covering 40 acres, and a Philippine exhibit covering 50 acres. See Fairs.

Ex'moor, a wild and hilly district in the extreme southwest of Somersetshire, extending also into Devonshire, England. It was formerly a forest, but, with exception of a considerable portion lately cultivated, it is now mostly heath and marsh. It embraces ranges of hills of considerable elevation (the loftiest being Dunkerry Beacon, 1707 feet), and in the time of the Druids was a favorite spot for the celebration of their religious rites. Red deer still exist here in a wild state. Good descriptions of Exmoor may be found in Blackmore's ‹Lorna Doone,› and Sir Conan Doyle's ‹Micah Clark.›

Exmouth, ěks'mŭth, **Edward Pellew**, Viscount, English naval officer: b. Dover, England, 19 April 1757; d. 23 Jan. 1833. He served as midshipman in the Blonde frigate during the American Revolution, and greatly distinguished himself at Lake Champlain. In 1809 he had attained the rank of vice-admiral, and in 1814 he was made Baron Exmouth. In 1816 he proceeded to Algiers in command of a combined fleet of English and Dutch ships to enforce the terms of a treaty which the dey had violated. He bombarded the city for seven hours, and inflicted such immense damage that the dey consented to every demand. Twelve hundred Christian slaves were by this exploit restored to liberty. Lord Exmouth was raised to the dignity of a viscount for this service.

Exmouth, England, seaport, market town in the county of Devon; on the English Channel at the entrance to the estuary of Exe. It is one of the favorite resorts, on the coast of Devon, for sea-bathing. The chief industry is fishing, and the shipping trade is considerable; the new docks are commodious. Exmouth was one of the principal ports of the country in the reign of Edward III.; but subsequently it became a mere fishing hamlet. Late years it has increased steadily in population and trade. Pop. about 10,500.

Exodus (Gr. «departure»), the name given in the Septuagint version to the second book of the Pentateuch, because it describes the departure of the Israelites from Egypt. The contents of the book, though not embracing such a variety of incidents as Genesis, are of a more diversified character, being not only historical, but also, and in a greater part, legislative. The subject-matter, arranged according to historical order, forms three divisions. (1) The condition of Israel in Egypt, and the preparations for their departure (ch. i.-xii. 36). (2) The march from Rameses to Mount Sinai (ch. xii. 37-xix. 2. (3) The abode in the desert and the promulgation of the Sinaitic Law (ch. xix. 3-xl).

Exog'amy, the usage by which in many primitive races a man is forbidden to marry a woman of his own stock or tribe. See MARRIAGE; TRIBE.

Exogenous (ěks-ŏj'ĕ-nŭs) **Plants,** an old and now disused name for dicotyledons. Monocotyledons were similarly known as endogenous plants, or endogens. See BOTANY.

Exophthal'mic Goitre, enlargement with turgescence of the thyroid gland, accompanied by protrusion of the eyeballs, breathlessness, palpitation, and anæmia. Also called Basedow's or Graves' disease (q.v.).

Ex'orcism, the act of expelling evil spirits by adjuration. The word is of Greek origin, *exorkismos,* from the verb *exorkizo,* which in classic Greek means to put one on oath, but in the New Testament to drive out by adjuration. Demonic possession was a notion generally entertained by the Jews in the time of Christ; and that it was entertained by Jesus Christ and his apostles is as certain as any fact recorded in the Scripture. Hence, till modern times it was believed by all Christians, though now it is repudiated expressly or tacitly, or is explained in a naturalistic sense, or at least ignored by very many who profess belief in the gospels as a divine revelation and the very word of God. The Catholic Church, while it does not stand committed to the popular beliefs of the faithful upon this matter, nor to the views even of her most eminent doctors, except so far as she may have formally adopted them in her authoritative symbols, claims to possess and to exercise in these days no less than in apostolic times the power to expel evil spirits from the obsessed or possessed. One of the minor orders of clergy in the Catholic Church is that of the "exorcist," and the ritual of the Church to this day has an official formula of prayers and adjuration for driving out demons. Pope Innocent I. (d. 417) forbade exorcists to exercise their ministry save with the express permission of the bishop, and that rule is still in force.

Ex'orcist, the name of one of the minor orders of the clergy in the Roman Catholic Church. See ORDERS, HOLY; EXORCISM.

Exosmo'sis. See OSMOSIS.

Exostem'ma, a genus of American shrubs and trees of the natural order *Rubiaceæ,* several species of which yield barks sometimes used in medicine. Though closely related to the genus *Cinchona* (q.v.) which yields quinine, the species of this genus are lacking in similar alkaloids. St. Lucia bark and Caribbee bark, obtained from West Indian species, are probably the best-known.

Exoter'ic. See ESOTERIC.

Exot'ic, an appellation for the produce of foreign countries. Exotic plants are such as belong to a soil and climate different from that to which they have been transplanted. It is implied that the exotic is more or less of a rare or tropical character and can be preserved only in greenhouses.

Expan'sion. See TERRITORIAL EXPANSION.

Expansion, in physics, is the increase in the bulk of bodies, in consequence of a change in their temperature. This is one of the most general effects of heat, being common to all bodies whatever, whether solid or fluid. The expansion of solid bodies is determined by the pyrometer, and that of fluids by the thermometer. The expansion of fluids varies considerably, but, in general, the denser the fluid, the less the expansion; thus water expands more than mercury, and spirits of wine more than water; and, commonly, the greater the heat, the greater the expansion; but this is not universal, for there are cases in which expansion is produced, not by an increase, but by a diminution of temperature. Water furnishes us with the most remarkable instance of this kind. Its maximum of density corresponds with 39.2° F. This fact is of the utmost importance in the economy of nature. When the surface of rivers and lakes is cooled, the superior layer of water sinks, and warmer water from below takes its place till the whole mass is cooled to 40°. After this the circulation ceases, and ice is formed. The maximum density point of sea water is considerably lower than that of fresh water, and varies with the quantities of the salts contained in it. The expansion of water is about the same for any number of degrees above or below the maximum density point. Thus, if we heat water 5° above 39.2°, it occupies the same bulk as it does when cooled down to 5° below 39.2°: and the density of water at 32° and at 53° is very nearly the same. The force with which water expands in the act of freezing is shown when glass bottles are filled with water and sealed; the glass is broken in pieces when the water freezes. A brass globe, whose cavity is an inch in diameter, may be burst by filling it with water and freezing it; and the force necessary for this effect is 27,720 pounds weight. The expansive force of freezing water may be explained by supposing it the consequence of a tendency which water in consolidating is observed to have to arrange its particles in one determinate manner, so as to form prismatic crystals, crossing each other at angles of 60° and 120°. The force with which they arrange themselves in this manner must be enormous, since it enables small quantities of water to overcome so great mechanical pressures. This observation is conspicuously illustrated by observing the crystals of ice on a piece of water exposed to the action of the air in frosty weather; or upon a pane of glass in a window of a room without a fire at the same season. Various methods have been tried to ascertain the specific gravity of ice at 32°; that which succeeded best was to dilute spirits of wine with water till a mass of solid ice put into it remained in any part of the liquid without either sinking or rising. The specific gravity of such a liquid is 0.92, which, of course, is the specific gravity of ice, supposing the specific gravity of water at 60° to be 1. This is an expansion much greater than water experiences even when heated to 212°, its boiling-point. We see from this that water at the instant of solidification receives a sudden and considerable augmentation of bulk. See HEAT.

Expatria'tion, the voluntary renunciation of the rights and liabilities of citizenship in one country, in order to become the citizen or subject of another. The right of a citizen of one country to renounce his allegiance in order to adopt another country as his own, has and is still much disputed. It seems most reasonable that the mother country and not the individual should decide the question. In the early part of the 19th century the United States was almost the only nation that claimed for individuals the right of expatriation without the consent of the government of which they were citizens or subjects. The European nations, as a rule, maintained that the permission of the sovereign was necessary; and the enforcement by England of this claim was one of the causes of the War of 1812. The right of voluntary renunciation of allegiance to the United States by one of our citizens was unsettled, so far as legislation was concerned, till the Act of Congress of 27 July 1868, asserted that expatriation «is a natural and inherent right of all people,» but the action of the department of State had previously seemed practically to admit the right. The first formal recognition of this principle was secured in an expatriation treaty with the North German Confederation, signed 22 Feb. 1868. England first recognized the right of voluntary expatriation by act of Parliament in 1870, and immediately concluded an expatriation treaty with the United States. All the leading nations of Europe now recognize the right, including besides those just mentioned, France, Austria, Russia, Italy, and Spain. The laws of the various nations upon this subject have been published by the United States government, under the title 'Opinions of the Principal Officers of the Executive Department and other Papers, Relating to Expatriation, Naturalization and Change of Allegiance' (Washington 1873). See also Citizen.

Expecta'tion. See Psychology.

Expectation Sunday, the Sunday before Whitsunday. Acts i. 4, Christ commanded the disciples «that they should not depart from Jerusalem, but wait for the promise of the Father.» They waited till the day of Pentecost and the promise was fulfilled.

Expectation Week, the week, or rather the nine days, which elapsed between the ascension of Jesus and the Pentecostal effusion of the Spirit, because during that interval the apostles and early Church waited in expectation that the promised Comforter would come.

Expectorant, a remedy used to increase the amount of secretion of the lower respiratory tract — the trachea and bronchi. Such remedies act: (1) Through nervous influences, like those of ipecac, antimony, senega; or (2) they increase the amount of blood flowing around the bronchi; or else (3) they stimulate the mucous membranes of the bronchi as they are excreted. To this latter class potassium iodide, chloride of ammonium, the aromatic balsams, and squills belong. They are useful in chronic stages of catarrhal bronchitis. See Bronchitis.

Expectoration, technically termed sputum, is a physiological secretion, but when there is an excess of secretion of mucus in the bronchi and trachea, which is expelled by hawking or coughing, it becomes a diseased condition. Excessive expectoration is found in bronchitis, in pneumonia, in tuberculosis, in gangrene of the lung, and in influenza. In all of these conditions the sputum carries the germ of the disease and should be disinfected. Miscellaneous expectoration in the street and public places should be prohibited by law. To properly disinfect the sputum, it should be received in a paper spit-cup or appropriate pocket-flask, and later destroyed. A mixture of carbolic acid, 1 to 25 of water, or of chlorinated lime, a teaspoonful to a pint of water, should be used in spittoons if these are essential. In cases of tuberculosis and influenza particularly, great care should be taken of the sputum and of all handkerchiefs, towels, napkins, and other linen that come in contact with the patient. See Disinfection; Influenza; Tuberculosis.

Expeditions to Latin America. See Discoveries of America.

Experiment, an operation designed to discover some truth, principle, or effect, or to establish or illustrate it when discovered. It differs from observation in the fact that the phenomena observed are, to a greater or less extent, controlled by human agency. Experiment distinguishes the modern method of investigating nature, and we owe to it the rapid strides made in chemistry, physics, and other sciences.

Experiment Stations, Work of. The agricultural experiment stations of the United States government now form the most complete system of agricultural research in the world. Over 1,000 trained and practical men are now employed in the 60 stations, which are now in operation in every State and Territory, including Alaska, Hawaii, Porto Rico and the Philippines. The annual income of these stations is about $1,500,000, of which sum one half came from the Federal government, and the other from State appropriations and other sources. The stations have existed as a national enterprise for 14 years, and the outlay for agricultural investigation in that time has been at the rate of $1 for nearly $3,000 worth of farm products, which cannot be considered an extravagant outlay.

Our farmers spend over $50,000,000 a year for fertilizers, and the stations have given particular attention to this subject. Fraud and extravagant assertions about fertilizers have been largely eliminated from the business and thousands of farmers are buying fertilizers more intelligently and economically. The annual loss to farmers from waste of barnyard manure is estimated at $7,000,000. Many of the stations have given special attention to the economic use of manure on the farm, with the result that better methods for its care and use are being employed. The successful introduction of Mansury barley, for which the Wisconsin station is mainly responsible, has increased the yield of barley over a wide region, with results worth millions of dollars. Kaffir corn was introduced about 15 years ago by the stations in California, Kansas and Oklahoma. It has been found specially suited to regions of scanty rainfall. The crop in Kansas alone one year was valued at over $6,000,000.

The various macaroni wheats which have been tested under varying conditions by a number of the stations, have proved so successful that the United States will probably produce all the macaroni it consumes in the course of a few years. The investigations of the experiment stations in the southern States have convinced farmers that many varieties of forage plants may be more successfully grown in the South than was supposed and have laid the foundation for a wide development of the live stock and dairy industries of that region. The department of agriculture and the Connecticut State station, co-operating with local tobacco growers, have within the last three years demonstrated that a fine grade of Sumatra wrapper tobacco may be grown under shade in the Connecticut valley. Prof. Whitney says that this discovery will increase the value of the light lands of the Connecticut valley over 200 per cent. The stations of the northwestern States have extended the limits of corn culture by proving, by careful selections of varieties and modified methods of culture, that this crop may be grown in regions heretofore believed to be unsuited to corn culture. The stations have been prominent in the investigations which have led to the new system of forcing vegetables in the field and under glass for supplying the markets with fresh vegetables at all seasons of the year. For example, the winter culture of lettuce in eastern North Carolina is now yielding over $100,000 a year. The Ohio station discovered that onions started in the greenhouse or under frames from seed and then transplanted to the open field produce larger onions and earlier and heavier crops than by the usual methods of tillage and seeding. This discovery is changing the methods of onion culture.

These are only a few of the many ways in which the experiment stations are helping agriculture. Their investigations relating to protective measures against plant diseases and injurious insects, the storage and utilization of fodder crops, breeding and dairying, the protection of farmers against fraud, and many other topics have been of the utmost value. See Agriculture; Agricultural Experiment Station.

Expert. See Evidence.

Expert Testimony. A branch of the law of legal evidence which may be defined as testimony in the form of an opinion, based upon facts proved in an action by other witnesses, or upon facts assumed to have been proved, concerning matters involving scientific or technical knowledge.

The value of expert testimony was recognized in the Roman law and was incorporated in that system of jurisprudence. In the law of some continental countries the system has always been firmly established. Indeed, in those countries, all forms of opinion evidence was and still is freely accepted: the courts giving it such weight as it seems entitled.

In the very earliest period of the English law, however, expert testimony was unknown. At that time a jury was selected from among persons already possessing knowledge of the facts of the case to be tried. In other words, during the early development of English law, the witnesses composed the jury and their verdict was based upon the facts within their own knowledge, and no effort was made to assist them. Gradually, however, the practice of taking testimony in open court came into vogue, and it was later seen, in order that an impartial verdict might be rendered, that the jury should be composed of unbiased persons, whose minds were not hampered by conclusions theretofore formed.

As a general rule in the English common law, which is, with slight modifications, the law of the United States, testimony of opinions has never been admitted as evidence. Our courts require and allow testimony as to facts only, and consider it the province of the court and jury to draw conclusions and form opinions from the facts proved. An exception to this rule is found in expert testimony. Since a jury represents only the average intelligence of the community, cases were early encountered where it was difficult or impossible for the jury to reach a reasonable conclusion from the facts proved before them, and to obviate the defect in the trial system, the courts gradually brought to its assistance expert witnesses, to aid in correctly determining questions presented. At that stage expert testimony was confined almost entirely to that of physicians. Causes of death or effects of physical injuries were then and still are the most common questions with which juries must deal, and the determination of such issues is dependent largely upon the opinions of skilled physicians, familiar with the conditions, testifying as experts. In later years in England and in the United States, expert testimony has been availed of to assist juries in various other classes of cases. The theory of the courts in allowing such testimony is, that the jury, or where the action is tried without a jury, the trial judge, is not competent to draw its own conclusion from the facts proved, without the aid of such testimony. In that event witnesses possessing technical or peculiar knowledge upon the subject are allowed to give their opinions as evidence for the enlightenment of judge or jury.

Within the last few years, the practice of employing expert testimony has grown rapidly and has resulted in the creation of a class of witnesses who might be termed professional experts, and who command large fees for their services. This has conduced to a result which has brought about much criticism, adverse to the system, based largely upon the fact that the testimony of expert witnesses involving lengthy technical discussions is one if not the principal cause of the unreasonable length of modern trials; upon the further fact that the testimony of the modern expert, with its technicalities and extreme length, tends rather to obscure than to enlighten the minds of a jury; but principally upon the fact that such testimony has proved in a great many cases to be so partisan as to be wholly unreliable. This criticism is not unmerited.

The creation of the class of so-called professional experts whose services demand large compensation has resulted in a condition where opposite opinions may be obtained in any number. Some of the recent prominent murder trials have hence afforded an interesting spectacle of arrays of experts with conflicting opinions retained by the respective parties, at great expense, whose examination and cross-examination has consumed days and even weeks, exhausting the patience of the judge, consuming the time of the courts, perplexing instead of clearing the issues, and weakening the confidence of the public in its system of justice.

Before the testimony of an expert witness is admitted, he must be qualified as an expert; in other words it must be shown by his own testimony that he has a knowledge derived from experience or study not possessed by the ordinary person in regard to the particular subject to which he intends to testify. Whether or not the witness has proved himself an expert is determined by the trial judge in his discretion.

The method usually adopted to get the testimony of an expert witness before the jury, after his qualification, is through the form of a hypothetical question. A question is put to the witness by the counsel of the party calling him. the question containing in detail the facts which the counsel believes have been proved and the witness is asked his opinion upon the assumption that the facts assumed are true. Such hypothetical question is often of great length, containing, as it does, a statement of facts that may have required days to prove. After the question is answered by the expert, he is usually subjected to a long cross-examination by the opposing counsel to test his skill and knowledge and the correctness of his conclusion. That the ordinary jury places little weight upon the conclusions of an expert based upon the facts contained in a hypothetical question, may be inferred from the fact that the counsel putting the question may assume facts which have not been proved to the satisfaction of the jury. Again the question is often so long involved that its meaning is soon lost.

In other cases, however, where the witness has knowledge of the facts, the hypothetical question is not necessary. For instance, the opinion of an expert in handwriting may be given after his comparison of the disputed writing with an admitted sample of handwriting used as a standard of comparison; and the physician who has examined a physical injury, or the alienist who has examined a person claimed to be insane, may testify as to his opinion based upon the knowledge acquired by him through such examination without the medium of a hypothetical question.

The courts do not consider expert testimony of great importance, or in any sense binding on the jury. It is allowed solely for the purpose of assisting the jury, and the courts take occasion to instruct a jury to attach such weight to expert testimony as in their minds it seems entitled or to disregard it altogether if they deem fit so to do. Such an instruction will be upheld even if there is no conflict in the expert testimony introduced.

In spite of the just criticism to which the modern development of expert testimony has been subjected, the doctrine has its uses and is necessary to our system of jurisprudence.

Thus, such testimony is absolutely indispensable to prove the custom in a trade; to prove the tensile strength of materials; the probable cost of buildings or works; the chemical composition of materials; the presence of disease and the cause and effects of disease or physical injury, and the cause of death; the seaworthiness of vessels and other nautical matters; and to assist the jury in various other matters not within the knowledge of the average judge or juryman.

Various remedies through legislation have been suggested to remedy the abuses to which expert testimony has been subjected, such as limiting the number of such witnesses to be called upon a trial; limiting the length of the testimony, forbidding an expert witness receiving any compensation beyond the ordinary fees of witnesses and even to the extent of forbidding expert testimony in some classes of cases, the most recent suggestion in connection with criminal cases being the creation of a board of experts retained and compensated solely by the state whose services may be invoked by either the people or the accused.

It may be suggested that the evil will, in time, work its own remedy through the agency of the courts without the aid of legislation. The judge presiding at the trial of an action has a wide discretion in allowing or disallowing the testimony of experts, and it may be said that a too liberal policy of allowing expert testimony without limit is largely the cause of the abuse.

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Exploration in America. As the routes followed by explorers of North America were determined by its physical contour, a brief geographical survey is necessary to understand the progress of its exploration. Thus considered, the continent divides itself into four geographic provinces: the Atlantic coast region, the eastern mountains, the central region, and the western mountains. The first embraces the coastal plain and Piedmont plateau lying east of the Appalachians; the second the Appalachian Mountains and their northern extension to the Gulf of St. Lawrence; the third the whole Mississippi Basin, the Great Lake region, and the Hudson Bay drainage. The last province is the great cordillera of western North America, which lies west of the Mississippi Basin and includes the Rocky Mountain system, Pacific Mountain system, and the Great Basin region lying in between.

The Atlantic seaboard, which was the scene of the earliest exploration and settlement, is separated from the central region by the Appalachian barrier. Hence the St. Lawrence, lying beyond the northern terminus of this barrier, is the only easterly flowing river which drains any part of the central province; and as in an unexplored wilderness watercourses naturally offer the easiest routes of travel, it was by its valley that explorers first penetrated the continent. A way through the barrier was found by following the Hudson and its westerly tributary, the Mohawk, which is connected with Lake Ontario by a lowland area.

The central province is covered by a network of waterways extending nearly two thirds of the distance across the continent, from the inland margin of the Appalachians on the east to the front of the Rocky Mountains on the west. It is separated by low divides into three distinct drainage systems: the rivers emptying into the Gulf of Mexico through the Mississippi; the waters which feed the St. Lawrence; and the rivers tributary to Hudson Bay.

The western mountain belt stretches northward from Mexico through the United States and Canada to the Arctic Ocean. Its southern section is interlaced by a series of rivers tributary in part to the Rio Grande, flowing into the Gulf of Mexico; and in part to the Colorado River, flowing into the Gulf of California.

The easiest route across the continent lay near the present northern boundary of the United States, where the head waters of the Missouri reach far into the western mountains, only 500 miles from the Pacific, and separated by but one divide from the Columbia River basin, which leads directly to the Pacific. Geographically, then, the explorations of our country fall into four groups: (1) those along the Atlantic seaboard, made by colonists of various nationalities; (2) those along the Mississippi, made by the

Spaniards from the south, the French from the north, and pioneers breaking through the passes of the Appalachians from the Atlantic seaboard; (3) those made by the Spaniards northward from the Mexican border; and (4) those of the western mountains, made by Americans and of comparatively recent date.

Though the Cabots discovered North America in 1497 and claimed it for England, it was Spain who first attempted its exploration. Ponce de Leon, who had sailed with Columbus on his second voyage and subsequently become governor of Porto Rico, set out in 1513 in search of the «Fountain of Youth.» Sighting an unknown coast at latitude 30° 8′, he named the land «Florida,» and turning south explored both sides of the peninsula. When he attempted nine years later to plant a colony on these shores, he was driven off by Indians.

But Spanish interest was aroused. In 1519 Cortes achieved his infamous conquest of Mexico, and the fame of its wealth inspired others to seek the New World. Pánfilo de Narvaez obtained a grant to conquer and govern Florida, by which was meant all the rest of the continent, stretching indefinitely northward from the Gulf of Mexico. With 300 men he landed at Tampa Bay in 1528, and marched northward, suffering terrible hardships. Disappointed at not finding the gold they sought, they returned to the coast near Appalachee Bay and set out for Mexico in improvised boats, but were wrecked by the way. Of the whole party, Cabeza de Vaca and three others were the only survivors. For six years they wandered: up through Mississippi across the Mississippi River near Memphis, along the Arkansas and Red rivers to New Mexico and Chihuahua; at last reaching Sinaloa on the Gulf of California, where they were found by Spaniards and taken to Mexico (1536).

Cabeza's written account of their experiences, published after his return to Spain, falsely attributed great wealth to Florida. So when Hernando de Soto, fresh from the conquests in South America, which had given him riches and fame, obtained permission to conquer Florida, many flocked to join him. He sailed in nine ships with 620 men, maintaining great display. Landing at Tampa Bay in 1539, the procession wandered westward, ill-treating the natives, for three years in pursuit of gold through the wilderness of the present Georgia, Alabama, Tennessee, and Mississippi to the banks of the Mississippi River. They crossed above the Arkansas, penetrated westward until frightened back by the roving prairie tribes, and returned to the Mississippi, where De Soto died and was buried in its waters at the mouth of the Red River (1542). His followers under Moscoso built seven brigantines, descended to the Gulf, and reached the Spanish settlement on the River Panuco, 311 survivors all told. Thus it was De Soto who first attracted attention to the Mississippi. Alonso de Pineda had discovered its mouth in 1519, and named it «Espiritu Santo,» and Cabeza de Vaca crossed it about 1530; but neither of them recognized its importance.

The fate of this expedition discouraged coastal exploration for a time. But the Spaniards in Mexico were already pushing their way up into the heart of the continent. In 1539 Marcos de Niza, a priest, penetrated New Mexico and came back with reports of the wealth of Cibola, a name which he applied to seven cities somewhere to the north. These were long supposed to be mythical, but have since been identified as the seven Zuñi villages in New Mexico.

The tale led Vasquez de Coronado to set out in 1540. Part of his expedition he sent by water up the Gulf of California under Hernando d'Alarçon, who discovered the Colorado River and ascended it for 85 leagues. The other part he led overland in the direction of Cibola, which he found and conquered (about lat. 35°); and then on into Kansas to about lat. 40°.

The belt of country bounding Mexico on the north received the name «New Mexico» from Antonio Espejo, an explorer who started north in 1582 with Indian guides to the rescue of three missionaries who had been deserted the previous year. Following the Rio Grande del Norte, he came to Cibola and, after learning that the missionaries had been killed, continued to explore the region, and returned by the river Pecos.

The colonizer of New Mexico was Juan de Oñate. He entered the country in 1597 with 130 families and founded the first capital, San Gabriel (second oldest town in the United States), near Santa Fé. In succeeding years he carried his explorations westward through Arizona, in 1604 following the Gila River to the Gulf of California. The following year he founded Santa Fé.

While this was going on in the interior, other nations were interested in the coast. It must be remembered that Columbus was in search of a western passage to Asia when he came upon America. But the idea did not die. A similar quest brought the Cabots to the shores of North America; and later, as the vast extent of the new country began to be realized, one explorer after another searched the coast for a water route by which to pierce the continent. When at last the waters of the St. Lawrence were found to lead no farther than the Great Lakes, explorers still pushed westward along the tributaries of the Mississippi or attempted to round the continent on the north through the ice-blocked seas.

In 1524 Giovanni da Verrazzano, sent by Francis I. of France, examined the shores from South Carolina to Newfoundland, and wrote to the king the first known description of them. He brought back a theory of an inland sea approaching the Atlantic coast about the middle of the continent; and it was to find this «Sea of Verrazzano,» as a possible route to Asia, that the king sent Jacques Cartier in 1534 to the Gulf of St. Lawrence (previously discovered by Jean Denys of Honfleur). In the course of three voyages he explored the St. Lawrence as far as Montreal, believing that he had found the western passage.

Cartier attempted to plant a colony near the site of Quebec; but for many years France's efforts in that line were doomed to failure. Equally unsuccessful were Jean Ribaut, who in 1562 brought over a band of Huguenot colonists to the site of Beaufort, S. C.; and René de Laudonnière, who founded Fort Caroline two years later at the mouth of the St. John's River, Florida. In 1565 Pedro Menendez de Avilés came to colonize Florida for Spain, and massacred the inhabitants of Fort Caroline. Laudonnière escaped to France, but Ribaut (who had just arrived from his second voyage with reinforcements for the colony) was killed while attempting to escape along the coast.

Menendez was the first to establish Spanish rule firmly in Florida. He founded St. Augustine (oldest town in the United States) in 1565, sent a mission to the Rappahannock in 1570, and explored Chesapeake Bay and the Potomac.

England sent out her first colonists to Jamestown, Va., in 1607. Among the number was Capt. John Smith, an indefatigable explorer of the neighboring rivers and Chesapeake Bay.

Another Englishman, Henry Hudson, sent out in 1609 by the Dutch East India Company, explored the coast from Nova Scotia to Chesapeake Bay, and then ascended the Hudson River to Albany. It was during the following year that, in the search for a northwest passage, he discovered the strait and bay that bear his name.

France first gained a foothold in North America through the efforts of Samuel de Champlain. The years 1603–7 he spent in exploring the St. Lawrence and the shores of New England, making the first accurate map of that coast. After he founded Quebec in 1608, he became interested in inland exploration, which twice led him into the United States: In 1609 he set out with 11 men to aid the Hurons against the Iroquois, descended the Richelieu in canoes, portaging part of the way, and pushed on through Lake Champlain to about Crown Point; and again in 1615 he accompanied a great war party of Indians by way of the New York lakes into the heart of the Iroquois country, south of Lake Oneida.

From this time fur-traders and missionaries spread over the country bordering the St. Lawrence and its tributaries, gradually approaching the Mississippi. The Spaniards had not followed up their discovery, failing to understand its importance. Nearly a century after De Soto's journey the French at the north began to have an interest in the Indian traditions regarding the «Great River.» About 1635 a trader, Jean Nicollet, was sent to a tribe near the head of Green Bay, Wisconsin. From there he went with Indian guides up the Fox River, portaged to the Wisconsin, and descended that until he came «near the sea,» as he reported; probably mistaking the «Great Water» described by the Indians for the sea. By 1658 two other French traders, Radisson and Groseilliers, reached the head of Lake Superior and explored the surrounding country.

When these rumors of a great river to the west reached Frontenac, the governor of Canada, he sent Louis Joliet to explore it in company with Jacques Marquette, a Jesuit. Meeting at St. Ignace, they set out with five men and two canoes, skirted the north shore of Lake Michigan and Green Bay, and ascending the Fox River, were guided by Indians across the portage to the Wisconsin, down which they passed, reaching the Mississippi 17 June. For one month they floated down the great stream, noting the mouths of its tributaries as they passed, until they came to an Indian village opposite the mouth of the Arkansas. By this time they knew that the river emptied into the Gulf of Mexico, and supposing themselves nearer the mouth than they actually were, they turned back through fear of Spaniards, returning by way of the Illinois and the western shore of Lake Michigan, which they reached by portage. Two years later Marquette met his death while attempting to establish a mission on the Illinois. His work among the Indians was taken up by Father Claude Allouez, also a Jesuit, who established several missions and traversed much of the country around lakes Superior and Michigan between 1665 and 1680.

Already another explorer was searching for the Mississippi. Robert Cavalier de La Salle was one of those who had come to Canada in pursuit of the passage to China, and guessed that it lay by way of the Mississippi, which he supposed emptied into the Gulf of California. In 1669 he crossed from Lake Ontario to a branch of the Ohio, and followed that river as far as Louisville. The next year he reached the Illinois from the end of Lake Michigan and explored it for some distance. For years he went back and forth through the region and established trade with the western Indians. In 1680 he sent Louis Hennepin, another Jesuit, with two men down the Illinois to ascend the Mississippi. On the way they were taken prisoners by the Sioux and carried up the great river to the Falls of St. Anthony, which Hennepin named. There they were joined by the famous trader Daniel Greysolon Du Lhut, who for two years had fearlessly explored the region around the end of Lake Superior and the head of the Mississippi. He had just come by way of the St. Croix River from his fort on the site of Duluth, and now joined Hennepin on his return journey by the Wisconsin.

At last, in 1682, La Salle attained his goal. With Henri de Tonty and a large party he reached the Mississippi from the foot of Lake Michigan by way of the Chicago and the Illinois, and descended to its mouth. On 9 April La Salle took possession in the name of King Louis of France and gave the name Louisiana to all territory drained by the Mississippi. After his return he sailed for France and obtained permission to transport colonists to the new province. He reached the Gulf of Mexico, but was unable to find the mouth of the river, and put in at Matagorda Bay. There he built Fort St. Louis, and then started overland to find the Mississippi and reach Canada to obtain supplies for the colonists, but was murdered by one of his men near a fork of Trinity River, Texas.

Where La Salle had failed, Pierre Le Moyne d'Iberville was to succeed. In 1699 he entered the Gulf of Mexico and explored the region around the mouth of the Mississippi, leaving a colony at Biloxi, which was afterward transferred to Mobile. With him was one already known as an explorer of the northern region, Pierre Le Sueur. He in 1695 had discovered and named the St. Peter (the Minnesota) River and observed a quantity of green earth near it; and now, in the belief that it was copper, he led a party of men up the river to work it and established a fort on the Blue Earth (Green) River.

Just at this time (1703) Baron La Hontan, a man who participated in many explorations in the north of the Valley, published an account of his wanderings which contains some valuable information with much that is false. He claimed to have discovered a river (La Rivière Longue) entering the Mississippi from the west near Lake Pepin, and to have followed it to its source in a large lake at the foot of mountains, on the other side of which was another river which emptied into the Pacific. This figured on maps for years before it was found to be fictitious.

The right to "farm out" this great country of Louisiana was granted to Antoine Crozat in 1714, and agents were immediately despatched to explore the tributaries of the Mississippi. Before the year was out St. Denis followed the Red River and crossed to the Rio Grande, where he came upon a Spanish mission and was imprisoned, sent to Mexico, and ordered to return. La Harpe in 1719 pushed up the Red River and across to the Arkansas, reaching lat. 37° 21′. He established a post among the Indians, claimed all this country for France, and defied the Spaniards in a letter to the Spanish governor. The exploration of the Missouri was attempted in 1719 by Du Tisné and followed up to six leagues above Grand River, at the peril of his life among hostile Indians, who attempted in vain to bar his passage.

In this southwestern section of the Valley French intrusion was resented by the Spaniards. Their claim to Texas rested on the exploration of its rivers by Francisco de Urdinola in 1575, and an expedition led across its borders by Hernando del Bisque in 1675. Farther west their control was assured by the work of missionaries. Father Kino, a Jesuit, had entered Arizona as early as 1658, and by 1679 had established five missions and become well acquainted with the country. On one of his expeditions he reached the mouth of the Colorado and discovered that Lower California was a peninsula, not an island, as was supposed.

With the expulsion of the Jesuits in 1767 the missions passed into the hands of the Franciscans, who inaugurated the era of Spanish exploration and settlement in California by a colony at San Diego in 1769. Years before pioneers from the east broke through the mountains and seized upon the country, these missionaries had permeated it and stamped their influence upon it.

Meanwhile the French at the north were every year sending traders and explorers into the interior. For some time they continued to use the routes followed by Marquette through Green Bay and by La Salle up the Chicago, but in 1716 they opened a new one by way of the Wabash, and another in 1720 by way of the Miami. A dispute over boundaries arose between the English and the French. Gov. Spotswood of Virginia urged upon the English the necessity of colonizing the Ohio Valley, and in 1716 made his fantastic ride with the "Knights of the Golden Horseshoe" to see if a way through the mountains could be found. He crossed the Blue Ridge and the Shenandoah Valley, but it was not until 1732 that the first settler, Joist Hite, entered the region.

Other efforts were being made to cross the mountains. When it was learned that the French were winning the allegiance of the Cherokees from the English, Sir Alexander Cuming, a Scotchman, set out in 1730 with a party from Charleston and made a circuit of 500 miles across the mountains, bringing back several Indians in token of renewed faith. In 1736 Col. William Mayo and a party of surveyors followed the Potomac to its springs and discovered a portage to waters flowing into the Monongahela. Another route was opened to the Kanawha, an affluent of the Ohio, in 1744 by Col. James Wood, a well-known frontiersman and explorer. Dr. Thomas Walker in 1748 led an expedition across the Virginia mountains, named Cumberland Gap and River, and made a circuit through West Virginia.

As the country became better known public interest awakened, and in 1748 a number of Virginians formed themselves into the "Ohio Company" for the purpose of colonizing the Ohio Valley. To anticipate them, the governor of Montreal despatched Bienville de Céleron down the Ohio to bury at the mouths of its tributaries plates inscribed with the declaration that all territory drained by those waters belonged to France. In spite of this, the Ohio Company sent out Walker in 1750 to survey lands for settlement. He explored Kentucky, and built the first house in the region now comprised in that State. Christopher Gist was also sent to explore routes to the north, select lands for settlement, and investigate the Indian tribes. He made a circuit of 1,200 miles north to the Scioto and Miami, and then south of the Ohio, visiting all the Ohio tribes, and returning by way of the Licking, Kentucky, and Roanoke rivers. On a second mission in 1751 he discovered a new gap from the Potomac to the Monongahela, and explored the Kanawha.

The next year Gist acted as guide to George Washington when he went as emissary from the governor of Virginia to the French fort at the head of the Ohio to protest against the French occupation of the valley. His mission was fruitless, but he brought back a map of his route: up the Potomac, across the divide, and along the Monongahela and Allegheny to the French fort near Lake Erie.

A most prominent figure in English exploration was George Croghan. Sent out by Pennsylvania in 1750 with the half-breed Montour to win over the Indians through the Ohio valley to the English, he went far and wide, from tribe to tribe, attaining an influence over the Indians which was of invaluable service to the English during the French and Indian war. When peace was declared he was delegated to prepare the Indians for English occupation. Starting from Pittsburg, he followed the Ohio, Wabash and Maumee to Detroit, and reported that the way was open; whereupon the English troops, under Capt. Thomas Stirling, advanced to Fort Chartres and took possession of the country east of the Mississippi.

And now, with English control assured, settlement spread rapidly beyond the Appalachians. Much of the preliminary exploration was made by hunters, trappers, and traders too numerous to mention, were they known. North of the Ohio the country was first settled by Moravian missionaries. Among the southern pioneers, James Smith followed the Kentucky and Tennessee rivers in 1766 and John Finlay explored northern Kentucky in 1767; but most prominent was Daniel Boone. His first venture was made in 1769, when he crossed the Cumberland Gap with James Robertson and spent two years exploring eastern Kentucky and Tennessee. Subsequently these two men took a prominent part in the settlement of this region.

With the advent of the American Revolution exploration received a check; but the expeditions of troops led by George Rodgers Clark into the Ohio basin 1778–9, and by Gen. John Sullivan into western New York were not without geographical value. And in the Indian wars which followed (1790–4) the American expeditions under Harmar, Clark, St. Clair, and Wayne added to knowledge of the Ohio Valley.

During the 17th and 18th centuries, while exploration and settlement had been pushed westward from the Atlantic seaboard over half-way across the continent, the Pacific coast was almost unknown. Balboa had discovered the Pacific at the Isthmus of Panama in 1513, and Cortes had sent several expeditions to the west coast of Mexico (1522–24). The first white man to reach the coast of California was the Spaniard Juan Cabrillo, who in 1542 traced it north as far as Monterey; and after his death the following year his pilot continued to Cape Mendocino. In 1576 the English seaman Drake reached lat. 43° in his coastal exploration. To the north the coast was unknown until Vitus Bering (1741), commanding a Russian expedition, visited it in lat. 60°. His voyage was followed by a swarm of Russian fur-traders, who, following the chain of Aleutian Islands during the latter part of the 18th century, gradually worked their way eastward and eventually reached the mainland of what is now Alaska.

In 1778 came Capt. James Cook, the famous English navigator, surveying the coast from Vancouver Island to the Arctic Ocean in his search for a northeast passage. When the published account of this voyage called attention to the rich fur-trade in the northwest, Americans were among the first to take advantage of it. In 1789 Capt. Robert Gray, of Boston, in the ship Columbia, cruised around the Horn and visited the northwest coast, carried a cargo of furs to China, and returned to Boston by way of the Cape of Good Hope. Thus was the American flag first carried around the world. On a second voyage in 1792 he discovered and explored the lower reaches of the Columbia River. This all-important achievement, besides disclosing an easy route from the western mountains to the sea — thus paving the way for trans-continental exploration — formed the chief basis of our territorial claim to Oregon. When George Vancouver, who was exploring the west coast with two British vessels (1792), learned of the Columbia River through Gray, he sent a boat expedition to investigate it. Afterward he continued northward to extend Cook's explorations on the coast of Alaska and British Columbia.

As yet none had succeeded in finding an overland route to the Pacific north of Mexico. Cabeza de Vaca, in his transcontinental wanderings, had turned to the south when he reached the mountains. A Canadian, Varennes de la Vérendrye, spent many years (1731–49) in the search for a route: at his own expense, for his government refused to back him. With his sons he made extensive explorations west of Hudson Bay, in the course of which he discovered (1731) the Red River and Lake Winnipeg, and his son Pierre penetrated to the forks of the Saskatchewan River (1739). In 1742 the two sons made a perilous journey to the southwest, across the Missouri and on to the Big Horn Mountains.

In the struggle for the Ohio Valley the western route was forgotten for a time. But when that contest was settled the quest was renewed by Jonathan Carver of Connecticut. In 1766 he made his way westward by canoe through the Great Lakes, and by Marquette's route to the Mississippi, which he ascended to the Falls of St. Anthony. He explored the Minnesota River, spent a winter among the Sioux, and in 1767 returned by ascending the Chippewa River and reaching Lake Superior waters by portage. While his journey added little to geographical knowledge, yet it served to awaken interest, and led Richard Whitworth to join Carver in planning a transcontinental expedition, which was unfortunately prevented by the outbreak of the Revolution.

Meanwhile the English fur-trading companies, through the journeys of their agents, had contributed much to geographical knowledge, not only of Canada but of the United States. The Hudson Bay Company, since it obtained its charter in 1670 and established its first post (Fort Rupert) on the great bay from which it took its name, had, in spite of French interference, extended along the shores of the bay and its tributaries. After the English conquest of Canada in 1763 it had a clear field until the appearance in 1783 of a rival "Northwestern Company," made up of Canadian merchants, which operated by the direct route from Montreal to the Great Lakes, and rapidly pushed its control throughout the north and west. Its influence was extended to the west coast by Alexander Mackenzie in a journey (1792–3) from Lake Athabasca up the Peace River and across the Rocky Mountains, the head waters of the Fraser River, and the Coast Range to the coast of British Columbia in the latitude of Queen Charlotte Sound. This was the first time the continent was crossed north of Mexico.

Thomas Jefferson in 1803 induced Congress to make an appropriation for the expenses of a transcontinental exploring expedition, a project that he had entertained for some 20 years. Nominally, Capt. Meriwether Lewis was leader of the party, with Lieut. (generally known as Capt.) William Clark second in command; but in point of fact all action was taken jointly, and the expedition is always known as that of Lewis and Clark. While preparations were under way the purchase of the territory of Louisiana from France gave additional importance to the enterprise. Lewis and Clark, with 43 men, left St. Louis, then a frontier trading-post, in three large boats, pushed their way up the Missouri, and built a fort at the Mandan Village, about 50 miles above the present town of Bismarck, N. D. From this point some of the party were sent back, and in the spring of 1805 the rest continued their voyage up the Missouri with 32 men. At the falls the heavy boats were left, and canoes were constructed to continue the ascent of the river. Near the head of what they named the Jefferson (the western fork of the Missouri) they cached their canoes, and with horses secured from the Indians crossed the Rocky Mountains to the Columbia, which they descended to the mouth, reaching the Pacific in November, 1805. After wintering here the party retraced their steps to the east side of the Rocky Mountains, and there separated; Lewis following the Missouri, while Clark traced the course of the Yellowstone. At the junction the reunited forces continued their rapid down-stream journey, reaching St. Louis in September, 1806. This was not only the most notable exploration ever undertaken by the United States government, but its complete success led to the many others which have followed up to the present day.

The head waters of the Mississippi were explored by Lieut. Zebulon Montgomery Pike, who ascended the river with a party of 20 soldiers in 1805. He reached Leach Lake drainage system and found the region already occupied by the agents of the Northwestern Company. Upon his return in 1806 Pike set out again with 23 men, with the idea of winning the allegiance of the Indians from the Spaniards and establishing an American claim to the region which had long been in dispute between the French and Spaniards. He ascended the Osage River in boats, and crossed overland with horses to the Pawnee villages, where he took up the trail of the Spaniard Malgares, who in the previous year had made an excursion into this region from Mexico at the head of several hundred troops. At the Arkansas Pike detailed Lieut. James Wilkinson to explore that stream to the Mississippi, and continued west with the larger section of the party, arriving in November at that high peak of the Rockies which now bears his name. During the winter, after terrible suffering from cold and hunger, he reached the Rio Grande. The Spanish authorities sent out a large force to capture the little band of explorers, and they were conducted back through what is now known as Texas.

The roving fur-traders were quick to penetrate the regions pioneered by Lewis and Clark and Pike. During the years 1806–9 they extended their excursions well into the Rocky Mountains from the east. In Canada the Northwestern Company, ever active, pushed its outposts westward; and in 1808 one of its agents, Simon Fraser, reached the Pacific at the mouth of the Fraser River.

In 1810 John Jacob Astor, a New York fur-trader, organized a company for the purpose of exploiting the trade on the Pacific slope. A vessel was despatched to the mouth of the Columbia River to establish a post, and an expedition sent overland to follow the Lewis and Clark route. This was the second party to cross the United States to the Pacific. Numbering three boats and sixty men under the leadership of one of the partners, Wilson Price Hunt, it left St. Louis in the late summer of 1810, and pushed its way up the Missouri about 450 miles. Here the party wintered, and in the spring continued by boat to the big bend of the Missouri; then with horses purchased from the Sioux proceeded overland in a southwesterly direction, crossed the Rockies near the head of the Big Horn River, and followed the Snake River Valley to the Columbia. With only a fraction of his large party, and after the most terrible suffering, Hunt reached the mouth of the Columbia in February, 1812, and found Astoria, the post established by the party sent by sea. The American company was only just in time: the previous year David Thompson of the Northwestern Company had portaged across the Rockies from the Saskatchewan to the head waters of the Columbia and followed it to the Pacific, where, much to his disgust, he found the Americans already in possession.

In 1812 David Stuart, with a small party, started eastward from Astoria to make the difficult and hazardous journey to St. Louis. He chose a route to the head waters of the Snake, across the divide to the Green River, a tributary of the Colorado, and across a second divide to the Platte, which he followed to its junction with the Missouri, and continued down stream to St. Louis, arriving in April, 1813, after a journey full of peril and hardship.

In 1814 Astoria passed into the hands of the Northwestern Company, which extended its trade over the entire Columbia River basin, and established posts at various points. The eastern slope of the Rockies was occupied by American traders, with headquarters at St. Louis and posts on the upper Missouri in the Green River Valley.

The government began to realize the importance of exploration. In the hope of discovering the sources of the Red River, a large expedition under Maj. Stephen H. Long left Pittsburg on a small steamer in April, 1819, wintered on the lower Missouri and during the following year made explorations and surveys in the country now included in Arkansas and Missouri. Long was sent again in 1828 to explore the head waters of the Mississippi, which he approached through the wilderness from the Miami River to Lake Michigan, thence to the junction of the Wisconsin and Mississippi, and on to the Minnesota: a difficult route, but lying in a region which had been explored by French pioneers more than a century before.

Still the source of the Mississippi had not been discovered. The head water region, previously visited by Pike, and long the stamping-ground of the fur-trader, had been again explored in 1820 by Gen. Lewis Cass, governor of Michigan, in company with Henry R. Schoolcraft. It was not until 1832 that the source was finally discovered in Lake Itasca by Schoolcraft and Lieut. J. Allen.

Capt. B. L. E. Bonneville, an officer of the U. S. army, in 1832 organized a party of trappers and hunters for the ostensible purpose of taking part in the fur-trade, but more to gratify his own ambition to explore the Far West. He left Fort Osage on the Missouri with 110 men, transporting his supplies by means of wagons, instead of using pack-animals, as all previous parties had done. Following Stuart's route of 20 years before along the valley of the Platte River, he crossed the mountains with his wagon-train and established a post at the head of the Green River. From this point as rendezvous his party scattered out in various directions, he himself exploring the Big Horn and Wind River mountains and extending one journey to the English trading-post on the Columbia. A party sent out by him visited Salt Lake, and continued through to the Spanish settlement of Monterey on the Pacific.

During the years 1833–5 the Rev. Samuel Parker, a zealous missionary, made several hazardous journeys from the Mississippi waters to those of the Columbia. At this time the Hudson Bay Company, which had absorbed its rival, the Northwestern Company, controlled the entire Columbia River basin, and claimed it for England, in spite of the protest of the few American settlers. In 1842 it came to the knowledge of the Americans that the English were making preparations to colonize the region, and it was necessary that the authorities at Washington should be informed at once. For this purpose Dr. Marcus Whitman and A. L. Lovejoy set out in the dead of winter on a journey of 4,000 miles across the continent. They took a southerly route through New Mexico to the Arkansas, and Whitman reached Washington.

In 1841 Lieut. R. E. Johnson of the United States Exploring Expedition, commanded by Charles Wilkes, U. S. N., crossed the Cascade Mountains near Mt. Rainier and, after making an extended journey in the Columbia River Valley, recrossed the Cascades to the coast. A detachment ascended the Willamette and crossed to the Sacramento Valley, which they followed to San Francisco.

With the exception of the Lewis and Clark expedition, the most important exploration of the century was done by Lieut. John C. Frémont, who had gained his first experience while assisting J. N. Nicollet, a French geodesist, employed by the United States government 1836-40, for making surveys in the upper Mississippi basin. In 1842 Frémont, with 25 men, among whom was the famous scout, Kit Carson, made surveys of a region lying between the Missouri River and the Rocky Mountains, along the valleys of the Kansas and Great Platte rivers. In 1843 he was instructed to carry his surveys to the Pacific coast. With a party of 40 men he made his way westward from the junction of the Kansas and Missouri rivers to the head waters of the North Platte, crossed to Green River, and traversing a region long known through the explorations of Bonneville and others, crossed another divide and descended Bear River to Salt Lake, which he explored. From there he went westward to the Snake River, and on to the mouth of the Columbia. After renewing the supply of provisions, Frémont retraced his steps to the Dalles of the Columbia, then turned southward to Klamath Lake, and made a hazardous journey through the Sierras which brought him into California along the valley of the American River, an eastern branch of the Sacramento. Traveling southward, he once more crossed the Sierras in lat. 35°, and returned to St. Louis across the Great Basin region and the Rockies. On his third journey Frémont crossed the Rockies from the head of the Arkansas to the Green River Valley, then continued westward around the southern end of Salt Lake across the Sierras, near where he previously traversed them, and then turned northward along the Sacramento Valley and across the mountains to Klamath Lake. Here he was impelled to turn back by the news of the uprising in California, and converted his exploring party into a military expedition.

The southwest became better known through military operations during the Mexican War, and after its close many expeditions were sent out by the government, under both military and civilian leadership, most of them, however, in regions already explored.

Public interest in the construction of a transcontinental railway led to five extensive expeditions during the years 1852-7: the first exploring along the 32d parallel; the second near the 35th; the third near the 38th and 39th; the fourth near the 41st and 42d; and the fifth near the 47th and 49th. Various military explorations and surveys were carried on west of the Mississippi up to the outbreak of the Civil War.

In 1869 Maj. J. W. Powell made a daring exploration of the Grand Cañon of the Colorado. With only a few men, in small boats, he followed the Green and Colorado rivers from Green River Station to the mouth of the Virgin River. In the next two years he extended this exploration in the Colorado basin under government auspices.

The Pacific railroad surveys practically completed the purely exploratory work of the United States; subsequent investigation was directed to minor details. During the years 1867-79 this work was carried on by various organizations which were created for both geographic and geologic research. Four of them were of especial note: "The Geological Exploration of the 40th Parallel," under Clarence King (King Survey); "United States Geographical and Geological Survey West of the 100th Meridian," under Capt. Geo. M. Wheeler, U. S. A. (Wheeler Survey); "United States Geological and Geographical Survey of Territories," under F. V. Hayden (Hayden Survey); "Geological and Geographical Survey of the Rocky Mountain Region," under J. W. Powell. In 1879 the United States Geological Survey was created for this purpose and the other organizations discontinued.

The acquisition of Alaska in 1867 gave American explorers a new field. This territory, occupying the northwest corner of the continent, is peninsular in form, its southern seaboard fronting on the Pacific. An almost unbroken system of mountains lies near the southern coast, forming a barrier which long prevented inland exploration. The broad, depressed interior area behind this mountain system is also cut off on the north and east by another range (the Rockies), which interposed a barrier between the interior of Alaska and that extensive system of waterways of northern Canada which was used by the explorer and fur-trader from the Atlantic coast. The central region opens out to Bering Sea, into which it pours most of its drainage through two great rivers, the Yukon and Kuskokwim: both navigable and affording easy access to the interior.

Alaska had been known to Russians since Bering's discoveries (1724 and 1741) and its coast-line had been explored by Russian fur-traders and naval officers, but more effectively by the English navigators, Cook (1778) and Vancouver (1793). The general shore-survey was continued by Otto von Kotzebue (German in Russian employ) in 1815, and by the English explorers, Sir John Franklin and Capt. F. W. Beechey (1826), Peter Warren Dease and Thomas Simpson (1837). The years 1849-53 saw a confirmation of the coastal exploration by Capts. Thomas E. L. Moore, Henry Kellett, Richard Collinson, and Commander Robert S. McClure, all H. M. S., and belonging to vessels of the Franklin relief expeditions.

In 1864-6 Robert Kennicott, Wm. H. Dall, and others of the Western Union Telegraph Survey, which had for its purpose the establishment of a telegraph line from the United States to Asia via Bering Strait, made explorations in the lower Yukon basin and ascended the full length of the river, about 1,800 miles. It had been traced from the sea for about 1,000 miles (1842-3) by Lieut. Zagoskin, and the Hudson Bay traders had reached it from the east in 1848 and established posts.

At the time of Alaska's transfer to the United States the coast-line had been explored practically throughout, but little was known of the interior; and for many years thereafter no official exploration was undertaken. Capt. R. W. Raymond, U. S. A., ascended the Yukon for 1,200 miles in 1869, but his journey was of no geographic importance. The pioneer fur-traders, among whom may be mentioned Jack McQueston, Arthur Harper, Fred Hunt, Joe Ladue, and Frank Densmore, made many hazardous journeys by which they extended geographic knowledge. Some time in the early seventies George Holt, a prospector, the forerunner of the great multitude to follow, made his way inland by way of the Chilkoot Pass and Lewes River; and by 1883, when Lieut. Frederick Schwatka, U. S. A., followed the same route, it had already become well established among miners and prospectors. In 1885 Lieut. Henry T. Allen made an exploration of the Copper, Tanana, and Koyukuk Rivers. Northern Alaska was explored (1883-6) by Lieut. George M. Stoney, U. S. N., and Lieut. John C. Cantwell and S. B. McLenigan, R. M. S. These expeditions mapped the Noatak, Kobuk, and upper Colville rivers, and Ensign W. L. Howard of the Stoney party extended the work through to the north Arctic coast. The journey of J. H. Turner, U. S. Coast and Geodetic Survey, in 1890 from the Porcupine River to the Arctic coast added to knowledge of northern Alaska. In 1890 E. J. Glave and Jack Dalton explored the Alsek River, which finds its way to the sea through the St. Elias Range. An exploration from the Yukon up the White River Valley to the Copper River was made in 1891 by Lieut. Schwatka in company with C. Willard Hayes, U. S. Geological Survey.

In 1898 the U. S. Geological Survey took up systematic surveys and explorations in Alaska. The first year George H. Eldridge and Robert Muldrow explored the Sushitna Valley; J. E. Spurr and W. S. Post the Kuskokwim Valley; and Alfred H. Brooks and W. J. Peters the White and Tanana river valleys. In the same year Capt. E. F. Glenn, U. S. A., and W. C. Mendenhall, U. S. G. S., penetrated overland from the head of Cook Inlet to the Tanana River. In 1899 F. C. Schrader and T. G. Gerdine explored the Chandler and Koyukuk valleys, while Peters and Brooks made a journey from Lynn Canal to the Yukon, exploring the northern front of the St. Elias Range. The same year Lieut. J. S. Herron, U. S. A., made an exploration in the upper Kuskokwim basin. Two years later the work in northern Alaska was extended by Schrader and Peters northward from the Koyukuk through to the mouth of the Colville, and by W. C. Mendenhall and D. L. Reaburn from the Yukon to Kotzebue Sound by way of the Kobuk River. In 1902 Brooks and Reaburn made an exploration from Cook Inlet through the Alaskan Range, along its northern base by the foot of Mt. McKinley, to the Yukon River.

In spite of all this activity, there are large areas of Alaska which have yet to be explored.

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Alfred H. Brooks,
United States Geological Survey.

Exploration in the 19th Century. Two phases of geographic research distinguished the 19th century from its predecessors. The largest discoveries of the 18th century were made by sailors — Cook, Carteret, Bougainville, Vancouver, and many others — who brought to light the myriad islands of the oceans or delineated unexplored parts of coast-lines. The largest discoveries of the 19th century, on the other hand, were made in the interior of the great land masses. It was the era of the study of the continents. The Cossack pioneers, in Russia's service, had crossed Siberia, but with this exception not a line of exploration had been run across Asia since Marco Polo in the 13th century till the second half of the 19th century brought forth its scores of Asian explorers. Nearly all our knowledge of the interior of Africa, Australia, and the larger part of North America is also the work of that century.

When Alexander von Humboldt described the travels which he began in South America in July 1799, he ushered in a new era of exploration; for he taught geographers that exploration does not consist merely of topographic delineation of mountains, rivers, plains, and settlements, but that it includes many other factors that have a bearing upon human interests — such as meteorology, climatology, the distribution of plants, and the nature of soils. He was the main pioneer influence in substituting scientific for superficial and unskilled exploration. Thus the 19th century was not only the greatest century in the study of the land surface of the earth, but also in scientific discovery.

South America, Africa, and Australia.— In their exploration, South America is the anomaly and Africa the wonder among the continents. South America is the only great region whose exploration on a large scale quickly followed European occupancy. The Amazon was known almost from its sources to its mouth, in the middle of the 16th century. Nearly all the coast cities on our maps were founded at that time, and a little later the Jesuits established their almost independent states in the heart of the continent; but to-day South America lags behind them all. Inner Africa, the geographical enigma 50 years ago, is better known. No railroad in Brazil penetrates so far inland as the African railroad to Matabeleland. South America is the part of the habitable world where most pioneer exploration remains to be done.

These facts are mainly the result of one potent influence that enabled the 19th century to contribute most largely to detailed geographical knowledge. It was the desire of the European powers to acquire more lands, widen commerce, and spread civilization that, in the past 50 years, has placed in the field scores of very costly exploring enterprises, many on a military basis, and fitted for really scientific work on a scale far beyond the scope of private achievement. South America has been outside this field of rivalry. Her days of largest exploration were when Spain and Portugal were great colonial powers. But early in the 19th century they lost that continent; and the republics which succeeded them, poor in purse and involved in many civil and external wars, have scarcely made the exploration of their own territories a state affair until within the past few years. The world knows far more of inner Africa to-day than the government at Bogota knows of the southeastern third of Colombia. Dr. Sievers has mentioned the fact that long series of meteorological observations in inner Africa are now available, while in large parts of South America — as in the llanos of Venezuela and most of the Amazon basin — there are no records of value for scientific deductions with regard to climate.

But the European nations did not enter upon this great task of studying the undeveloped continents till they received the impulse from the humble pioneers of discovery. Stanley says he thought Livingstone was an enthusiast and a visionary when they stood together on the shore of Tanganyika, and the great missionary-explorer, with uplifted hand trembling with weakness, told him the day was coming when the civilized nations would see the good in Africa and set about the reclamation of the continent. It was Livingstone, first of all, and his successors, who started the movement, which gathered volume and momentum till we see a continent one third larger than our own parceled out among the European powers, which have practically completed exploration on broad lines, and are studying it in detail.

Twenty years ago the country back of the west coast of Australia was an unknown Sahara, through which only three or four travelers, at the risk of their lives, had pushed their way. Then it was discovered that this frightful waste was the treasure-house of western Australia, guarded from all intruders by thirst and famine. The entire topography of this spinifex-covered desert has now been revealed. This exploration was made possible by the fact that the great modern agent of civilization, the railroad, was pushed out into the desert at various points, so that thousands of men, with supplies daily replenished from the coast, may live there and find and develop the gold resources. This illustrates the fact that many inventions of the 19th century which facilitate the development of little-known lands have stimulated the work of discovery because they have made it easier to obtain substantial results for business as well as for science by exploratory enterprises.

Better Knowledge of Our Own Country.— The text-books which our school children used 100 years ago told them nothing of the Rocky Mountains or of the ranges of the Pacific slope. The exploration of three fourths of our vast domain has been the work of our government and private citizens. In a broad sense, it has been well done; and in the past 25 years it has been succeeded by detailed studies and surveys which should be specially mentioned, for they are a phase of exploration never carried out on a large scale till the 19th century, and which is essential to the production of the most accurate maps. No topographic feature or town or distribution of economic resources can be mapped with the greatest attainable accuracy till these surveys are made. They involve, (1) The preparation of a topographic map showing the relief or inequalities of the surface, the drainage, and the works of man, such as roads, railroads, boundaries, and towns; (2) the geologic map, printed in colors upon the topographic base map, showing the distribution of the rock formations, soils, useful minerals, artesian waters, etc. These surveys and the resulting maps are one of the most scientific developments of geographic research in the 19th century. They have been completed in all countries of Europe except in Norway, Spain, Turkey, and some of the Balkan states. The great survey of India is one of the monuments of cartography, and similar surveys are far advanced in Algeria and Tunis. The topographic work has been carried by our general government, with the assistance of a few states, into all the States and Territories, and about a third of our entire area has now been completed. The labor is enormous and costly, and many years will elapse before the whole country can be mapped with the refinement and accuracy that characterize the map sheets of the most of Europe.

Mapping the Ocean.— Oceanography, one of the largest departments of geographic science, may be said to be wholly a development of the 19th century. It was not known before that the sea-bottom, like the land, has its mountains, valleys, and plateaus. It was believed that life could not exist at depths below 1,500 feet; but we now know there are forms of life at the bottom of the deepest oceans. Ingenious appliances have been invented for exploring the depths of the sea, and the world has to-day a general idea of the contour of the ocean floor, and of the conditions of movement, temperature, salinity, and life that prevail at different sea-depths. Nearly all these additions to knowledge have been made in the last 50 years. The science of limnology is not 30 years old. This is the study of lakes, their depths, color, transparency, life, and other characteristics. It has been widely pursued in Switzerland, France, and Germany, and, to some extent, in other countries.

Blank Spaces on the Map.— The whole of North America south of subarctic latitudes has now been carefully explored, and the 13 large areas in northern British America, to which Dr. Dawson referred as unknown, not many years ago, have passed out of that category or been greatly reduced in size by such work as Ogilvie has done on the upper Yukon, Low in Labrador, and the Tyrrell brothers in the Barren Lands. Next to Europe, North America is the best-explored part of the world, though 60 years ago more than half the continent was not so well known as most of Africa is to-day. It is only a question of time when all the habitable territory of the United States and Canada will be as thoroughly studied and mapped as that of the European states.

Central America still offers a large field to the explorer. The long, gentle slopes from the central mountains to the eastern coasts, continually drenched by the trade-wind rains, have a luxuriant and almost impenetrable vegetation, and are still very little known. It is on the drier Pacific side of these little states that development is mainly centred.

Most of the additions the 19th century made to South American exploration were the work of European and North American explorers, many of them poorly equipped and paying their own way. Their most conspicuous service has been the mapping of the drainage and explorations in the northern and central parts of the

Cordilleras. The Spaniards long ago revealed the courses of the Amazon and La Plata-Paraguay, but they paid little attention to smaller streams and tributaries. It was left to the 19th century, and particularly to its last three decades, to explore these rivers, and we now have an excellent idea of all the large features of the drainage system. European explorers have made Ecuador better known than Colombia simply because they have been attracted to the Ecuadorian Andes as a specially inviting field. Political or military influences have mainly incited exploration so far as the states have participated in it. Thus the important wars that Argentina waged in 1879-80 with the Indians of the south, and in 1884-5 with those of the north, had the incidental result of making large parts of Patagonia and the Gran Chaco fairly well known.

Explorations in South America.— When Chile and Argentina based their boundary treaty of 1881 upon inaccurate geographical knowledge they sowed the seeds of an international quarrel. The result was that both began to survey the Cordilleran regions in dispute, and the resulting maps of the entire Andean Territory between Cape Horn and lat. 39° S. are specimens of excellent survey work, and have revealed a hitherto unknown region. Explorations in South America are of very uneven merit. Many are only crude route surveys. Argentina is by far the best-mapped country for its geological and meteorological departments, and the staff of foreign professors in the higher schools placed exploration and mapping, after 1882, on a high plane. The Brazilian government has never promoted scientific exploration, and all official work in that line has been done by a few states, mainly by Minas Geraes, São Paulo, and Pará. Most of the far interior, away from the rivers, is still unknown. The Amazon basin is one of the largest unexplored areas in the world; for, though steamers sail regularly on the main stream and many tributaries, the stretches between the rivers have not been visited. The inland parts of the Guianas and of the cordilleran countries from Venezuela to Bolivia are still in the crude and early stages of exploration.

What a contrast Africa presents! A hundred years ago the world had knowledge only of its coasts, Egypt, some of the Barbary Coast lands, bits of Senegambia, and the upper Niger, revealed by Mungo Park, and the Cape of Good Hope for 120 miles inland. All the rest was a blank on the maps. The last inhabited area of importance that was wholly unknown a few years ago, that between Lake Rudolf and the Nile, has been crossed by the American explorer, Dr. Donaldson Smith. The least-known part of Africa is now the Sahara and Libyan deserts, which have been neglected, on the whole, though a great deal has been done to reveal their character. This neglect is due partly to the small economic importance of these regions, but mainly to the hostility of the natives.

Pioneer Exploring in Asia.— Nearly three quarters of a century ago it was said before the British Association: «We have only a general knowledge of the geographical character of the Burman, Chinese, and Japanese empires; the innumerable islands of the latter are still, except occasionally, inaccessible to European navigators. Geographers hardly venture on the most loose description of Tibet, Mongolia, or Chinese Tartary, Siam and Cochin-China.» Since that time a swarm of explorers have overrun nearly every portion of Asia. India is as well mapped as any part of Europe, and that great survey is now being extended over Burma. Japan is mapping her own rugged islands by the most detailed and scientific methods. There are only two regions in that largest of all the continents where pioneer exploring may now be done. One of them is in central and southern Arabia, where there are still large areas, probably sandy desert, that are wholly unknown. The other is in Tibet, the highest of plateau regions, where there are large gaps to be visited between the lines of exploration run by many Russian, British, and French explorers and the American, Rockhill. Thus the era of running route surveys in Asia was closing with the end of the 19th century, and the work of detailed exploration, completed in India, is now rapidly extending.

Our knowledge of Australia, like that of Africa, is the gift of the 19th century. A number of explorers, of whom the best known was Dr. Leichardt, have perished in the waterless and repellent waste that covers the vast interior. But this sandy desert is now marked in all directions by the tracks of explorers; and one of the most practical features of their work was the discovery, around the desert margins, of wide areas of grazing lands that are making Australia one of the greatest of stock-raising countries. The interior of eastern New Guinea, the largest island except Greenland, has been opened to our knowledge within the past 20 years by the British and Germans, who wished to ascertain the nature of their new possessions. The fact that the western half of the island is still almost unknown seems to show that its masters, the Dutch, have lost the zeal that placed their fathers among the hardiest and most enthusiastic explorers.

Polar Explorations.— In Polar exploration, the 19th century scarcely excelled the splendid achievements of earlier ages, though it added many new islands to the maps, attained the farthest north, and, what is perhaps most important, perfected the art of living and traveling, in comparative safety, in the high latitudes. It may be that the archipelago north of this continent will be considerably extended by later explorations, but there are good reasons for believing that the still unknown Arctic area contains no great land masses. The unknown part of the Antarctic regions is twice as large as Europe, and contains the largest unexplored area in the world. Already the present century has entered upon explorations in that quarter which promise important results. Practically every Arctic expert now believes that Lieut. Peary has established the fact of his discovery of the North Pole and this achievement is accepted as the completion of the pioneer exploration of the entire world.

Cyrus C. Adams,
Fellow of the American Geographical Society.

Explosion, a sudden bursting, generally due to the rapid production of gaseous matter from solids or liquids. Thus the explosion of gunpowder is due to the sudden formation and expansion of gases into which the powder is converted by chemical agency. Explosions are often caused by the elastic force of steam confined in boilers, and by spontaneous combustion. See EXPLOSIVES.

Explosive Gelatine, blasting gelatine or gum dynamite, an explosive material resembling wine jelly in appearance. It was invented by Nobel in 1878, and consists of soluble cellulose nitrate dissolved in nitroglycerin. Originally, the solution was effected by warming the nitroglycerin and adding the perfectly dry soluble cellulose nitrate, called nitro-cotton, little by little, with stirring, whereby the nitroglycerin was made to dissolve from 4 to 10 per cent of the nitro-cotton: Then the solution was effected by the aid of a solvent like acetone, which was afterward evaporated off. All of these processes of manufacture were dangerous. In 1889, Lundholm and Sayer discovered that if the nitroglycerin and nitro-cotton are mixed with warm water and stirred up by compressed air, gelatinization sets in, and may be completed by pressing out the water and working the mass in malaxating machines. Explosive gelatine is a gelatinous mass, looking something like new honey in color, and varying in consistency from a tough leather-like material to a soft jelly, in accordance with a variety of circumstances, such as the quantity and chemical composition of the nitro-cotton used, and the methods of manufacture. In general, the thinner the gelatine, the more sensitive it is to detonation; but, on the other hand, a thin gelatine is more subject to liquefaction and possibly also to exudation, which would make it dangerous in storage, transportation and use. Specially strong detonators are required to explode blasting gelatine; or else ordinary detonators together with primers of dynamite or gunpowder. In order that detonation should be transmitted through a mass of explosive gelatine it must be confined; for, unlike dynamite, a train of it cannot be exploded in the open, except by means of an extremely powerful initial detonation. The sensitiveness of the material is still further diminished by the solution in it of camphor, or other substances rich in carbon and hydrogen, like benzine or nitro-benzine. Explosive gelatine containing camphor has been proposed for use as a bursting charge for high explosive shell, under the name of «military explosive gelatine.» While dynamite and nitroglycerin when frozen are much less liable to be exploded by a blow, such as that given by a rifle bullet, the reverse is true of frozen explosive gelatine. Though while in the unfrozen condition explosive gelatine is less sensitive to shock or blows than either nitroglycerin or nitrocellulose, it is, when exploded, a more powerful explosive than either of them. This is due to the fact that when nitroglycerin is detonated, there are unused oxidizing materials in the gaseous products; and when cellulose nitrate is detonated, there are unused combustible materials in the products. When, therefore, these bodies are mixed in the right proportions, the products will be those of complete combustion. Explosive gelatine has the advantage over dynamite in that it is practically unaffected by water and therefore can be stored in water. It is, on the whole, less liable to freeze than dynamite. It possesses an advantage over guncotton, in being plastic and can, therefore, better adapt itself to the irregularities of the bore-holes in loading. The specific gravity of explosive gelatine is from 1.5 to 1.6. If heated slowly, beginning at 60° C., it will explode at 204° C. (399.2° F.). On rapid heating it explodes at 240° C. (464° F.). If ignited when frozen even small quantities may explode. Pure explosive gelatine is never used excepting either for blasting in unusually tough rock or for blasting under water, or for military purposes. It is put up in cylindrical «sticks» in paper wrappers like dynamite. For general use in blasting it is too violent, and therefore «gelatine dynamites» are made by mixing this costly and powerful material with diluents. A great many different dopes are used, but a good example of a gelatine dynamite is «gelignite,» which is made by mixing 65 per cent of explosive gelatine with 35 per cent of an explosive wood-pulp dope, giving a substance consisting of nitroglycerin 62.5 per cent, nitro-cotton 2.5 per cent, sodium nitrate 26.25 per cent, wood pulp 8.4 per cent, and sodium carbonate 0.35 per cent. It is interesting to note that «ballisti,» which is a smokeless powder, is also made by dissolving nitro-cotton in nitroglycerin, but while explosive gelatine contains at the most but 10 per cent of nitro-cotton ballistite contains 40 per cent of this material.

Explosives (from Lat. *explosus,* p.p. of *explodere,* to drive out, to drive out a player with clapping, to explode; from *ex,* out + *plaudere, plodere,* to clap, strike, applaud), are substances which easily react at comparatively low temperatures with the formation of a considerable volume of highly expanded gas, the evolution of heat and light and the production of sound. At ordinary temperatures they may be solid bodies like gunpowder or liquid like nitroglycerin or gaseous like fire damp mixtures. They may consist wholly of a single chemical compound like mercuric fulminate, or of mixtures of combustible substances with supporters of combustion or oxidizing agents like blasting powder, which is a mixture of charcoal, sulphur, and sodium nitrate. Though the temperature is different for each explosive they can all be caused to explode if heated to the explosion temperature, which for nitrogen chloride is 93° C.; mercuric fulminate, 152° C.; emmensite, 165° C.; nitrostarch, 175° C.; dynamite, guncotton, and nitroglycerin each, 180° C.; blasting gelatine, 204° C.; blasting powder, 270° C.; picric powder, 273° C.; rifle powder, 275° C.; best sporting powder, 315° C.

History.— The inventor of gunpowder, the oldest of explosives, and the place where it originated, are not known. The invention has been ascribed by different authors to Marcus Græcus, Albertus Magnus, Roger Bacon, and Berthold Schwarz; to the Arabians, whose works were largely used by Marcus Græcus in his writings; to the Hindus, because of certain passages occurring in the code of Gentoo laws prepared by Indian savants by order of Warren Hastings in the 18th century; and to the Chinese because of certain statements made by Marco Polo. There seems to be little doubt that this confusion exists (1) because modern meanings have been given to words and phrases used in the old manuscripts; (2) because of the intentionally confusing methods employed by the writers of the Middle Ages; and (3) because gunpowder for use in guns was not the invention of any one person, but was really the result of a progressive development.

It is recorded that what moderns call «Greek fire,» and the ancients called «naphtha,» was employed in the defense of Constantinople in the 7th century and that these fiery compositions were propelled against the enemy by means of arrows from bows, or in hollow vessels of stone or iron thrown by war engines. Though consisting at first of pitch, rosin, sulphur, and similar easily inflammable and highly combustible substances, it is easy to imagine that in the tentative development of these materials of war nitre was added to the combustible substances and that there was thus produced a deflagrating composition for use as bursting charges in bombs and grenades and for the manufacture of devices analogous to modern firecrackers and rockets with which to frighten and confuse their foes.

The supposition that gunpowder was known before it was applied for use in guns is supported by the older historians. All the components and mixtures for Greek fire similar to gunpowder were already known in the time of Hassan-al-Rammah (1290). From an exhaustive search of the literature Guttmann arrives at the conclusion «that gunpowder was gradually developed from Greek fire, and that it was known for years before cannons and guns were thought of. The use of purer materials in making it developed its propulsive power, and led to the subsequent invention of cannons and guns. The Arabians were the first to make gunpowder-like mixtures, probably about 1280 A.D., while the idea of utilizing their propulsive force, that is, the invention of guns and cannons, belongs to the monk, Berthold Schwarz, of Freiburg, Saxony; the date of the latter invention being probably 1313 A.D.» It is accepted as indisputable that gunpowder mills existed at Augsburg, Germany, 1340, and at Spandau, Germany, 1344, and that the English used gunpowder in guns at the battle of Crécy, 1346.

Though many improvements were made in the manufacture of gunpowder, such as in the preparation and purification of the raw materials from which it was produced; the methods of incorporation; and its granulation to adapt it to special uses, this substance remained unrivaled until the end of the 17th century, when the French chemist, Berthollet proposed the substitution of potassium chlorate for the potassium nitrate and produced by this means a much stronger and quicker powder, but one which was also much more dangerous than gunpowder. Beginning with the discovery of mercuric fulminate by Howard, an English chemist, 1880, there was added to the achievements of the 19th century the discovery of nitrogen chloride by the French chemist Dulong, 1812; nitrostarch by Braconnot, 1832; guncotton by Schoenbein of Basel, Switzerland, 1845; nitroglycerin by Sobrero at Turin, Italy, 1846; the invention of blasting powder by L. DuPont of Wilmington, Del., 1856; the discovery of diazo compounds by the German chemist, Griess, 1860; the invention of dynamite by A. Nobel of Sweden, 1866; smokeless sporting powder by Schultze of Potsdam, Germany, 1867; blasting gelatine by Nobel, 1878; military smokeless powder by Vieille of France, 1886; hard-grained smokeless sporting powder by Richard von Freeden of Walsrode, Germany, 1889; homogeneous smokeless powder composed of a single chemical substance in a state of chemical purity by Charles E. Munroe of Newport, R. I., 1890; and the discovery of triazoic acid by Curtius of Kiel, Germany, 1890, while in the meantime picric acid, which was discovered by Hausmann, 1788, was shown to possess explosive properties and adapted for use in shell, it having been pointed out by Sprengel, 1873, that it contains a sufficient amount of available oxygen to render it, without the help of foreign oxidizers, a powerful explosive when fired with a detonator.

This growth has been coincident with the development of the chemical and physical sciences and has been the more rapid, the more completely experimental methods of research have been perfected and applied. In addition to those enumerated above this advance in the science and art of explosives has been chiefly due to the labors and intelligence of Hess, Lauer, Trauzl, and von Lenk in Austria; Abel, Cundill, Debus, Dewar, Dixon, Dupré, Majendie, and Noble in England; Berthelot, Chalon, Daniel, Desortiaux, Gay-Lussac, Lavoisier, Le Chatelier, Mallard, Maurouard, Roux, Sarrau, Turpin, and Violette in France; Bunsen, Dittmar, Guttmann, Liebig, Meyer, Schischkoff, Upmann, Will, von Förster, and von Romocki in Germany; Abbot, Barnard, Craig, Emmens, Judson, Hill, Maxim (q.v.), Mixter, Mowbray, Quinan, Rodman, Count Rumford, and Woodbridge in the United States; Mendeléeff in Russia; Cronquist in Sweden, and Hebler and Lunge in Switzerland. Because of their prominence in this science Abel and Berthelot deserve special mention.

Sir Frederic Augustus Abel, K.C.B., D.C.L., chemist, was born in London 1827 and died 6 Sept. 1902. He was tutor to Edward VII., the present king of England; professor of chemistry at Woolwich 1851; chemist to the war office 1854–88; chairman Government Committee on Explosives 1888; member of Royal Commission on Accidents in Mines; president of the London Chemical Society, Society of Chemical Industry, Institute of Chemistry, Institute of Electrical Engineers, Iron and Steel Institute, and of the British Association for the Advancement of Science; he perfected the manufacture of guncotton, making it a valuable explosive; conducted with Capt. Nobel elaborate researches on fired gunpowder; together with Prof. Dewar invented the smokeless powder, known as cordite, which was adopted and used by the British government; and was the chief authority in the United Kingdom on explosives and explosions. Among his published works may be cited: ‹Guncotton› (1866); ‹The Modern History of Gunpowder› (1866); ‹On Explosive Agents› (1872); ‹Researches on Explosives› (1875); ‹Electricity as Applied to Explosive Purposes› (1884).

Marcellin Pierre Eugène Berthelot, chemist, was born in Paris 25 Oct. 1827, and has been professor of chemistry in the Collège de France since 1865; member of the Institute 1873, perpetual secretary of the Academy of Sciences 1889; inspector-general of higher education 1876; life member of senate 1881; minister of public instruction 1886–7; minister of foreign affairs 1895–6; he has achieved equal fame for his researches, discoveries, and philosophical deductions in synthetic chemistry, thermochemistry, explosives, and historical chemistry. Among his published writings may be cited: 'Chimie Organique Fondée sur la Synthèse' (1860); 'Mecanique Chimique Fondée sur la Thermochimie' (1879); 'Les Origines de l'Alchimie' (1885); 'Sur la Force de la Poudre et les Matières Explosives' (1871, 1872, and 2 vols. 1879). The last was translated into English, 'Explosives and Their Power' (1892).

Theory of Explosives.— When wood or other combustible substances containing hydrogen and carbon are ignited in contact with air they burn, giving forth heat and light and are converted into water and carbon dioxide, which pass off as invisible and highly expanded gases. As the wood is subdivided so as to expose a continually increased surface to the air the rapidity of the combustion is increased until, when the wood is reduced to dust like sawdust and suspended in the air so as to be intimately mixed with it, the velocity of the combustion is so great and the evolution of the gases so rapid that the reaction becomes an explosive one and such a mixture of sawdust and air is an explosive. All inexplosive combustible substances can, when finely divided and intimately mixed with air, form explosives, and volatile liquids and gases are especially likely to do so. Many accidents have arisen from the ignition of mixtures of air with the dust of charcoal, coal, flour, malt, soap, starch, sugar, zinc, wood, and other solids; with the vapors of alcohol, ether, gasoline, and other naphthas, spirits of turpentine and other liquids, or gases like acetylene, coal gas, hydrogen, and marsh gas since each of these substances, though in themselves non-explosive, form explosive mixtures with air if they be mixed with it in the right proportions. The best proportions are those in which the volume of oxygen in the air present is just sufficient to convert all of the hydrogen in the combustible into water and all of the carbon into carbon dioxide, or, in other words, to produce complete combustion. Less violent explosions may occur when the proportion of air is greater or less than the "best proportion," the limit being fixed in each case by the character of the combustible substance, the quantity of the mixture, the temperature and pressure to which it is subjected and the manner in which it is ignited. Mixtures of these substances whose proportions are outside of these limits may be ignited and may burn, but do not explode.

If pure oxygen in the proper proportions be substituted for air in the above mixture the velocity of the reactions will be still greater, and the energy set free in unit of time and consequently the violence of the explosion will be greatly increased. Besides the proportions that determine the limits between explosion and combustion will be extended. Such mixtures if confined and out of contact with the air will still take fire and explode. Oxygen may be supplied either in the free state or in solid bodies which contain it and which give it up when heated to comparatively low temperatures. Among such solids are the nitrates of metallic radicles, like ammonium nitrate, potassium nitrate (India saltpetre), and sodium nitrate (Chile saltpetre); chlorates such as potassium chlorate; peroxides like sodium peroxide, and many others. If these solids be dried, finely divided, and intimately mixed with a combustible, in the right proportions, a solid explosive is produced. Often, as in the case of mixtures of charcoal and saltpetre the temperature to which they must be heated in order that combustion shall begin, called the point of ignition, is so high that they are difficult to ignite and in such cases a small portion of a substance like sulphur, which has a low point of ignition, is incorporated in the mixture.

Another method by which oxygen may be brought into intimate contact with combustible bodies so as to form an explosive is through the action of nitric acid upon them. Two cases present themselves. First when the combustible body is a simple or mixed primary alcohol and the nitric acid reacts with the acidic hydrogen. Second, when the combustible substance is a hydrocarbon or its derivative and the nitric acid reacts with the hydrogen of the hydrocarbon or the hydrocarbon nucleus. The products of the first case are organic nitrates called also nitric esters. The products of the second case are nitro-substitution compounds. Examples of the first case are ethyl nitrate from ethyl or grain alcohol, glycol nitrate from ethylene glycol, glyceryl nitrate (nitroglycerin) from glycerol (glycerin), mannitol nitrate from mannitol (mannite), starch nitrate (nitrostarch) from starch, and cellulose nitrates (guncotton and pyroxylin) from cotton. Examples of the second case are mono and di nitro benzene from benzene, tri nitro phenol (picric acid) from carbolic acid (phenol), and nitro-naphthalenes from naphthalene. These explosives differ markedly from mixtures like gunpowder, for, whereas in the mixtures the combustible substance and the oxidizing agents are in different masses, in the explosive compounds like nitroglycerin, they are both in the same molecule. Therefore in the latter the contact is more intimate and the reaction takes place with greater velocity.

In addition to the explosives of the characters lescribed above is another class of chemical compounds, of which mercuric fulminate, silver amine (fulminating silver) and diazo benzene nitrate are notable examples, whose explosive properties are due to a phenomenon (namely, a molecular disruption), which is quite unlike that of combustion ascribed to those of the previous classes. This case of disruption arises from the fact that these substances are endothermous compounds, or in other words, that they absorb heat during their formation and are therefore reservoirs of energy.

Classification of Explosives.— Following the foregoing theories of their constitution and behavior, explosives may be classed as

(1) *Nitrate mixtures.*— Amide powder (charcoal, potassium nitrate, and ammonium nitrate); amidogene (bran or starch, charcoal, magnesium sulphate, potassium nitrate, and sulphur); azotine (petroleum, charcoal, sodium nitrate, and sulphur); blasting powder (charcoal, sodium nitrate, and sulphur); carbazotine (bark or wood pulp, lampblack, ferrous sulphate, potassium nitrate, and sulphur); Courteille's triumph safety powder (charcoal, peat, coal, oleaginous matters [animal or vegetable], metallic sulphates, sodium nitrate, and sulphur); diorrexine (sawdust, sodium nitrate, potassium nitrate, and sulphur); fractorite (rosin, dextrine, potassium dichromate, ammonium nitrate); gunpowder (charcoal, potassium nitrate, and sulphur); haloxyline (charcoal, sawdust, potassium ferro-

cyanide, and potassium nitrate); Himly's powder (hydrocarbons and potassium nitrate); Nordenfeldt and Meurling's powder (hydrocellulose, potassium nitrate, and sulphur); pyrolithe (charcoal, sawdust, sodium carbonate or sulphate, potassium nitrate, sodium nitrate, and sulphur); saxifragine (charcoal, barium nitrate, and sulphur).

(2) *Chlorate mixtures.*— Asphaline (hydrocarbons, potassium sulphate, potassium nitrate, potassium chlorate); Berthollet's powder (charcoal, potassium chlorate, and sulphur); britainite (naphthalene, potassium nitrate, ammonium nitrate, potassium chlorate); Callow's powder (orpiment, potassium ferrocyanide, and potassium chlorate); carlsonites (naphthalene, or dinitrobenzene, and other combustible substances with ammonium perchlorate); comet powder (rosin and potassium chlorate); cycene (cane sugar, paraffin oil or coal dust, potassium nitrate, and potassium chlorate); Ehrhardt's powder (tannic acid, charcoal, rosin, potassium nitrate, and potassium chlorate); Hahn's powder (charcoal, spermaceti, antimony sulphide, and potassium chlorate); Himly and von Trutschler-Falkenstein's powder (coal tar, potassium nitrate, and potassium chlorate); Horsley's powder (nutgalls and potassium chlorate); Kellow and Short's safety powder (tanbark or sawdust, potassium nitrate, sodium nitrate, potassium chlorate, and sulphur); Knaffl's powder (ammonium ulmate, potassium nitrate, potassium chlorate and sulphur); Melland's paper powder (porous paper which has been soaked in a paste composed of starch, charcoal, potassium ferrocyanide, potassium chromate, potassium nitrate, potassium chlorate, and water and dried); Oriental powder (gum gambier and potassium chlorate); Parone's explosive (carbon disulphide and potassium chlorate); Pertuiset's powder (sulphur and potassium chlorate); pyrodialites (mixtures of coal tar with chlorates or perchlorates and with or without nitrates, nitrosubstitution compounds, charcoal, and oxidizing salts); pyronome (rye flour, charcoal, metallic antimony, sulphur, potassium chromate and potassium chlorate); rossellite (asphalt oil and potassium chlorate); Siemen's powder (a solid hydrocarbon, potassium nitrate, and potassium chlorate); thorite (cane sugar and potassium chlorate); tutonite (metallic sulphides, sulphur and potassium chlorate); and white powders of Augendre and Pohl (cane sugar, potassium ferrocyanide, and potassium chlorate).

(3) *Oxidizing mixtures.*—These are mixtures of combustible substances with oxidizers other than the nitrates, chlorates or perchlorates. Among such bodies may be named sodium peroxide, potassium permanganate, potassium dichromate, liquid air, and liquid nitrogen tetroxide. As examples we have mixtures of sodium thiosulphate with sodium peroxide; metallic aluminum with sodium peroxide; cotton wool with liquid air, and panclastite, which is a mixture of carbon disulphide with liquid nitrogen tetroxide.

(4) *Organic nitrates or nitric esters and mixtures containing them.*— Esters: Guncotton, which is a cellulose nitrate of high nitration and practically insoluble in a mixture of ether and alcohol at ordinary temperatures; nitrocellulose, a term applied to all cellulose nitrates; nitroelectrite (isomannitol nitrate); nitroerythrite (erythrol nitrate); nitroethyl (ethyl nitrate); nitroglucose, a nitrate produced from grape sugar; nitroglycerin, pyroglycerin or glonoin oil (glyceryl trinitrate); nitrolactose (nitrated sugar of milk); nitrolignin (nitrated wood); nitromannite (mannitol nitrate); nitromethyl (methyl nitrate); nitrostarch or xyloidine (starch nitrate); nitrosugar or nitrosaccharose, a nitrate produced from cane sugar; pyroxylin, collodion cotton, nitrocotton or pyrocellulose, are cellulose nitrates of medium nitration and practically completely soluble in a mixture of ether and alcohol at ordinary temperatures. In this class is also to be included the explosive mixtures into which these esters enter as essential components and of which the dynamites are conspicuous examples. These are classified, according to the nature of the *dope* or absorbent, into

A. *Dynamites with an inert base.*— Nobel's dynamite No. 1, giant powder No. 1; dynamite blanche de Paulilles; dynamite de Vonges; E. C. dynamite; S, 1, dynamite; Rutenberg's explosive; dynamite rouge, all consist of nitroglycerin with kieselguhr; Hill's powder (nitroglycerin with precipitated silica); Mowbray's mica powder (nitroglycerin with asbestos); Hercules powder (Extra No. 1); (magnesia powder, nitro-magnite; dynamagnite; fulgurite; nitroglycerin with magnesia alba); dynamite de boghead (nitroglycerin with ashes from Boghead coal); selenitic powder (nitroglycerin with plaster of Paris); Horsley's powder No. 1 (nitroglycerin, alum, and magnesium sulphate); metalline nitroleum (nitroglycerin, red lead, and plaster of Paris); renish dynamite (nitroglycerin, kieselguhr, and naphthalene); dynamite noire (nitroglycerin, sand, and coke); mataziette (nitroglycerin, sand, ochre, charcoal, and resinous matter); porifera nitroleum (nitroglycerin, sponge, or vegetable fibre, and plaster of Paris); Burstenbender's explosive (nitroglycerin, spongy vegetable substances with glycocoll or chondrin); Morse's explosive (nitroglycerin with rosin); Borland's carbo-dynamite (nitroglycerin with charcoal from cork); white dynamite (nitroglycerin with lime-guhr); boritine (nitroglycerin, kieselguhr and boric acid); fluorine (nitroglycerin, kieselguhr, and calcium fluoride).

B. *Dynamites with an active base.*— *a.* Consisting of nitroglycerin absorbed by a gunpowder like dope — Ammonia dynamite; ammonia krut; ammonia powder; Coad's explosive; Champion's powder; colonia powder; Dittmar's powder; dynamite No. 2; dynamite au charbon; dynamite d'ammoniaque; dynamite grieses de Paulilles; extra powder; Fowler's explosive; giant powder No. 2; Gotham's powder; Hercules powder; Horsley's powder No. 2; Judson's powder; Jupiter powder; lithofracteur; Monakay's explosive; miner's powder Co. dynamite; Neptune powder; potentia; petrolithe; sebastine; thunderbolt powder; Titan powder; virite powder; Vulcan powder.

b. Consisting of nitroglycerin absorbed by or gelatinized with a cellulose or ligno-cellulose nitrate — Blasting gelatine; cellulose dynamite; Clark's explosive; Dean's explosive; Dittmar's explosive; extra dynamite; explosive gelatine; glyoxyline; grisoutine; gum dynamite; nitrogelatine; paleine; Punshon's explosive; Schultze's dynamite; straw dynamite; Trauzl's dynamite.

c. Consisting of nitroglycerin or an explosive gelatine incorporated with wood pulp or sawdust and a nitrate, principally sodium nitrate. Such dynamites are styled lignin-dynamites — Ætna powder; amidogene; Atlas powder; Brain's powder; carbonite; diaspon; dualin; dynamite de Krummel; dynamite de Lanky; forcite; gelatine dynamite; gelignite; giant powder; Hecla powder; meganite; miner's friend powder; grisoutite; kadmite; petralithe; rendrock; rhexite; safety nitropowder; Schultze dynamite; stonite; stowite; vigorite.

d. Other dynamites.— Americanite (nitroglycerin and methyl alcohol); Castellano's powder (nitroglycerin, fibrous material, earth and nitrobenzene); cerberite (nitroglycerin, wood oil, nitrobenzene, wood pulp, and sodium nitrate); Engle's powder (nitroglycerin, ammoniacal salts, saltpetre, pyroxyline, nitrostarch, nitromannite, nitrobenzene, and water glass); glukodine (nitroglycerin and nitrosaccharose); perunite or terrorite (nitroglycerin, nitromethyl, nitroethyl, and pyroxylin); thunder powder (nitroglycerin and nitroglucose).

C. *Organic nitrate mixtures other than dynamites.*— Casteau's explosive (nitrodextrine and ammonium nitrate); Cooppal's powders (resinous bodies, barium nitrate, and nitrocellulose); diflamyr (metallic nitrates and nitrocellulose); flamminore (collodion cotton, ammonium sulphate, and ammonium nitrate); grenée powder (paraffin; agar-agar, nitrocellulose, potassium nitrate, and barium nitrate); explosive P, (nitrocellulose and ammonium nitrate); potentite and tonite (guncotton and barium nitrate).

5. *Nitrosubstitution compounds and mixtures containing them.*— Compounds: Nitrobenzenes; nitrocresols; nitrocumenes; nitronaphthalenes; nitronaphthols; nitrophenols; nitroresorcinols; nitrotoluenes; picric acid or cabazotic acid (trinitrophenol); picramic acid; styphnic acid or oxypicric acid (nitroresorcinol).

A. Mixtures containing nitrosubstitution compounds.— Abel's powder; ammonite; amvis; bellite; boritine; Borlinetto's powder; Boyd's powder; bronolithe; Brugere's powder; explosive A; explosive C; explosive N; cremonites; Du Bois-Raymond's powders; duplexite; ecrasite; emmensite; Faversham powders; Favier explosives; ferrifractor; Fontaine's powder; Gathhurst powder; gelbite; Geserick's powder; Girard's powder; hellhoffite; Hill's powder; Johnite; joveite; kinetite; lyddite; melinite; oxonite; rackarock; roburite; romite; securite; streetites; Volney powders.

(6) *Fulminates.*— Compounds: Copper acetylide; diazobenzene nitrate; fulminating gold (auramine); fulminating silver (argentamine); mercuric fulminate; mercuric triazotate; nitrogen chloride (chloramide); nitrogen iodide (iodamide); silver fulminate; and triazoic acid, also called hydrazoic acid and azoimide.

In addition to these classes there are four groups of explosives which have received such widespread notice as to merit especial mention here, though the members of each may all be and many of them are included in the classes given above. These groups are Sprengel explosives, safety or flameless explosives, permitted explosives, and smokeless powders.

Sprengel Explosives.— These explosives were invented by Dr. Hermann Sprengel, 1873, and he advocated their use because of their safety, as they are non-explosive during manufacture, storage, and transportation, but are very powerful explosives when prepared and detonated. His plan was to employ mixtures of combustible and oxidizing substances, which should be kept separate until needed for use, the bodies to be employed in the compounding of the explosives being either all liquid or part liquid and part solid, for by taking advantage of the liquid state speedy and intimate mixing could be realized and the explosives could be compounded on the spot and at the time they were wanted for use. Among the oxidizing agents proposed were the nitrates and chlorates, which are solids, and nitric acid and nitrogen tetroxide, which are liquids. Among the combustible substances were the nitrosubstitution bodies, carbon disulphide, and petroleum. A conspicuous example of a Sprengel explosive is rackarock, which was used in blowing up Flood Rock in Hell Gate, N. Y., and which may be made by pouring mononitrobenzene upon potassium chlorate crystals. Other examples are some forms of emmensite; explosive A; hellhoffite; oxonite; panclastite; and Parone's explosive.

Safety or Flameless Explosives.— These explosives are for use in fiery mines, particularly coal mines, where there is a chance of an accident arising through the ignition of the fire damp from the flame or incandescent particles given off by the explosive as the blast is fired. Among the earlier devices employed to prevent this was the mixing in the dope of the dynamite or with the powder of a quantity of washing soda, alum, Epsom salts or other salt containing a large amount of water of crystallization that would be set free when the mixture was fired. In 1883 Mallard and Le Chatelier discovered that when explosives were detonated unconfined in air containing 10 per cent of methane (marsh-gas), the fire damp could not be ignited if the temperature of detonation was below 2200° C., owing to the cooling of the gases due to their rapid expansion and to the retardation of the inflammation of the fire-damp. An investigation by the French Fire Damp Commission showed that, among others, certain salts of ammonia and especially ammonium nitrate, were capable of reducing the temperature of the gases produced by detonation very materially, the temperature of the gases from explosive gelatine being reduced from 3090° C., when detonated alone, to 1493° C., if detonated when mixed with 88 per cent of ammonium nitrate. In August 1890 the French government prohibited the use of black powder in fiery or dusty mines and permitted the use in them of explosives whose gases are not combustible and the detonation temperature of which does not exceed 1900° C., where blasting is to be done in the rock, nor 1500° C., where the work is to be done in the coal seam. Among the explosives designed to meet such conditions and styled abroad safety or flameless explosives are: Ammonite; amvis, aphosite; bellite; benedite; britainite; cambrite; Casteau's explosives; dahmenite; Favier's explosive; fractorite; Geserick's powder; grisoutine; grisoutite; nitroferrite; progressite; roburite; securite; westphalite; wetterdynamite.

Permitted Explosives are those which have passed the prescribed tests of the governmental authorities in Great Britain and whose sale and use is authorized under carefully prescribed conditions.

Smokeless Powders are high powdered propellents used as substitutes for gunpowder in firearms and cannon. They are formed of the highest grade of cellulose nitrate only, like indurite, or of the medium grade only, like pyrocellulose powder, or they may be mixtures of different grades together with metallic nitrates like the B. N. powders. Another class are mixtures of cellulose nitrates with nitroglycerin and a restrainer, like vaseline; ballistite, cordite, and filite being examples of this kind. In robin-hood, gold dust, and gelbite, we have examples of such powders made from nitrosubstitution compounds and oxidizing agents. Other smokeless powders are amberite; Brackett's powder; cannonite; Curtis and Andre's powder; Du Pont powder; E. C. powder; fulgor; granulite; hornite; J. B. powder; kolfite; poudre J; poudre S; pyrocollodion; rifleite; Schultze powder, and Walsrode powder.

Methods of Firing Explosives.— Explosives may be made to explode by heating them to their explosion temperatures. This may be accomplished by a flame, a spark, an incandescent body, friction, percussion, concussion, pressure, or chemical action, provided the resulting temperature is sufficiently high. Gunpowder was originally ignited in muskets, guns, and boreholes by the application of a torch, a glowing tinder, or a heated iron rod. Later muskets were fired by the sparks from a flint striking steel. Joseph Egg, an English gunmaker, 1815, invented percussion caps, and to-day all fixed ammunition is fired by percussion primers, while the charges in very large guns are fired by friction primers or by electric primers. In firing blasts a train of powder was laid from the mine to a safe distance by which to convey the inflammation. Later quills, straws, or paper or wooden tubes were used to hold the train and permit of the charge being tamped so as to secure the advantage which comes from confining an explosive. Bickford of Tuckingwall, England, 1831, invented the «running» or «tape» or «safety» fuse, in which a core of gunpowder is enclosed in a tube of jute yarn impregnated with a waterproof composition, and this is to-day largely used in firing blasts. Dr. Watson of England, 1745, succeeded in igniting gunpowder by means of electric sparks, and in 1749 a battery of 11 guns was fired by means of a frictional electric machine at Annapolis, Maryland. Dr. Robert Hare of Philadelphia, 1832, invented the method of firing gunpowder charges by means of the electric current, using low tension fuses, and he had for some time prior to this employed the voltaic battery, in eudiometrical experiments, for igniting explosive mixtures of gases. Sir Charles Wheatstone, 1856, introduced the magneto-exploder in blasting, and Moses G. Farmer, of Newport, R. I., 1871, invented the dynamo-electric machine with which to generate the current and applied it to firing electric ignitors or detonators, and to-day great guns, military and naval mines, and torpedoes and many blasts, especially those in which several charges are to be fired simultaneously or where the blast is under water, are fired by this means.

It has long been known that when a notable quantity of a mixture of two volumes of hydrogen with one volume of oxygen is ignited at any point, the inflammation extends almost instantaneously throughout the mass and a most violent explosion ensues. This phenomenon is called detonation, and this mixture has long been known under the name of detonating gas. Certain chemical compounds such as nitrogen chloride, nitrogen iodide, and mercuric fulminate undergo an almost instantaneous decomposition, giving rise to violent explosive effects, if heated, struck or rubbed, and they are known as detonating explosives. At first guncotton, nitroglycerin, and dynamite were fired by ignition as gunpowder had been, but Nobel, 1866, discovered that if a quantity of mercuric fulminate was detonated in contact with nitroglycerin or dynamite they then underwent a detonating explosion also. E. O. Brown of the chemical department at Woolwich, England, 1868, discovered that not only could dry compressed military guncotton be detonated in this way, but that if the dry charge, called a primer, was in contact with wet guncotton, the latter was detonated also, even though it was saturated with or submerged under and in contact with water. There are then two kinds of explosion, namely, explosion by simple combustion and explosion by detonation. Explosives of the gunpowder class undergo only the first kind of explosion. Explosives of the nitric ester or nitrosubstitution classes undergo both kinds of explosions. Explosives of the fulminate class practically undergo only the second kind of explosion. A marked difference between the two kinds of explosion is found in the velocity with which the explosive reaction is propagated within the mass of the explosive. Thus in detonating gas, which can undergo both kinds of explosion, Bunsen found, when using very narrow tubes where only combustion could take place, that the velocity of the reaction was 34 metres per second, while Berthelot, using long and wide tubes in which detonation could take place, found that the velocity of the reaction was 2,810 metres per second. Experiments made by laying trains of the materials and firing them showed that while the velocity of combustion of gunpowder in the open air is but from 1.5 to 3.4 metres per second, the velocity of detonation of dynamite and of guncotton is about 6,000 metres per second. Provided each explosive gave the same volume of gases, having the same temperature and that the conditions were in all other respects alike, it is evident that the explosion in which the reaction velocity was the greater would be the more violent one. But they are not alike since guncotton, nitroglycerin, and mercuric fulminate, besides being endothermous compounds, are completely resolved into gases, while gunpowder, besides being a mixture, yields but about 44 per cent of gaseous products. The pressure developed by gunpowder when fired in a space completely filled by it is, from Noble and Abel's experiments, 6,150 atmospheres. The theoretical pressures developed by guncotton, nitroglycerin, and mercuric fulminate when detonated in contact with bodies, are respectively 24,000 atmospheres, 25,000 atmospheres, and 28,000 atmospheres. Investigation has shown that no other explosive known will give in contact an instantaneous pressure at all comparable with that of mercuric fulminate.

Owing to these differences in behavior explosives have been distinguished as high explosives and low explosives. Gunpowder and explosives of the nitrate class, together with smokeless powder are low explosives. They act with comparative slowness and are used where it is desired to lift or push a load without cracking it or in propelling projectiles. Nitroglycerin and explosives of the class of nitric esters or nitrosubstitution bodies are high explosives. They are shattering and crushing in their effect. Detonators containing mercuric fulminate are used to fire high explosives, the detonators being themselves fired by means of a Bickford fuse or by an electric current. The high explosives are usually put up for use in paper cylinders, and, when loaded for shipment, these are called cartridges or «sticks.» Usually several sticks are required for one borehole. In this case the detonator is inserted in one of these sticks, usually the last one inserted in the hole, and this stick is then called the priming cartridge or «primer.»

Direction in Which Explosives Explode.— There is a very common but erroneous belief that gunpowder explodes upward and that high explosives explode downward. It arises from the fact that if a quantity of dynamite be laid unconfined upon the surface of the rock on detonating it the rock will often be fractured, whereas if gunpowder is thus placed and fired, it produces no effect whatever upon the rock. The facts are that each explosive tends to act in all directions about the centre of explosion. As exposed in air they are subjected to the weight of the air above them, and are to that extent under confinement. When the high explosive is detonated the gases are set free so fast that the air acts as a tamping agent; when the gunpowder explodes the gases are generated so slowly that they have time to move the air. Besides the «pressure in contact» exerted by the high explosives is enormously greater than that of the low explosives. That high explosives exert pressure in all directions may be easily demonstrated by fastening blocks of guncotton of equal size and weight on opposite sides of a plate of iron, but at some distance apart, by means of light cords or wires, suspending the plate in any position and detonating both charges simultaneously when holes will be blown through the plate away from each of the charges. Although high explosives usually produce a shattering effect when fired unconfined upon a body the effect is markedly increased by increasing the confinement. Thus in the method of breaking boulders and large masses of stone called «plastering,» after the charge is laid upon the stone and fused, one or two shovelfuls of earth are placed over it before firing. In «blockholing,» when it is desired to break the rock into fragments of definite size, a small hole is bored in the rock and the explosive inserted in this cavity whereby the gases obtain a greater leverage.

Explosions by Influence.—In detonating explosive substances it has been found that the influence of the detonation is exerted to a distance all about the mass depending on the kind and the amount of the explosive used and its environment and that a second charge of explosive within the sphere of influence may be detonated by the detonation of the first charge without being in contact with it. Thus in accidental explosions in explosive works the initial explosion occurring in one building may detonate the explosives in other buildings unless care is taken in the construction of the works to separate the buildings by a safe distance from one another. Care, too, must be taken in forming fixed ammunition that the primers are not heavily charged with fulminate, and that the cartridges are so packed that the accidental explosion of one cannot explode the others by influence. Application of this principle is made in military engineering in the operation of countermining, the enemy's submarine mines being blown up by firing a heavy torpedo charged with guncotton in the vicinity of them. To-day large quantities of explosives are frequently used in big blasts. According to Eissler, it is an almost daily occurrence in California for 20,000, 30,000, and even 50,000 pounds of explosives to be used in a single charge. The system of large blasts has even become common in hard rock excavations, such as quarries and railroad cuttings, and in these large blasts it is common practice to dispose the larger part of the mass of explosive so that it may be exploded by influence and not by contact or by propagation of flame or fire.

The largest single blast ever fired was that used in the blowing up of Flood Rock at Hell Gate in the East River, N. Y., 10 Oct. 1885. There was used in the blast 240,399 pounds of rackarock and 42,331 pounds of dynamite, or 283,000 pounds of explosive. There were 13,000 separate charges of rackarock embedded in drill holes with a dynamite cartridge on top of each, and there were 591 primary charges of dynamite placed on timbers 25 feet apart within the mine. When all the charges had been placed in the excavation and the primary charges connected with the firing batteries, the mine was filled with water, the primary charges were exploded by the electric current and these exploded the 13,000 other charges by influence through the intervening water. Munroe founded on this principle a method of testing the relative sensitiveness of explosive substances.

Uses of Explosives.— The uses of explosives as propellents in war and in the chase; as rupturing agents in mining, quarrying, and engineering operations; and as an essential component of fireworks is well known. It is not so generally known that they are employed for saving life and property in signal lights, rockets, and guns; in projecting lines from the shore to stranded ships, and, in case of fire, to the upper stories of high buildings; in casting oil upon the water to quell a raging sea; and in railroad torpedoes to prevent collisions. Gunpowder guns are also used in bridge building to project a line across a chasm which is to be bridged, and they are used in the whale fishery to project the harpoons, while the latter may carry an explosive charge with which to stun or destroy the whale. Detonating explosives have been improperly used in taking fish; in burglarious operations against safes and vaults and in anarchistic outrages. Dynamite has been used to knock the blocking from the ways when launching ships. Fired on an iron plate placed on the top of a pile and covered with a tamping of earth or clay, it has successfully replaced the pile driver. It has been found efficient in excavating holes in which to plant telegraph and telephone poles and fence posts; in driving water out of quicksands in which foundations are to be laid or shafts to be driven; in slaughtering cattle; in breaking down ice dams to prevent inundations; in blowing up buildings to prevent the spread of conflagrations; in razing unsafe walls of burned buildings; in destroying wrecks which endanger navigation, and in freeing vessels which are hard aground on shoals. The farmer uses them in breaking boulders, grubbing stumps, and felling trees; in shaking the soil to fit it for deep-soil cultivation, and, in wine growing districts, to free the soils from the phylloxera: while their aid has been sought in breaking droughts and diverting hailstorms from their courses. The iron founder uses them in breaking large castings. The iron smelter employs them to clear out obstructions in blast furnaces while the latter are still in operation. Munroe proposed using detonating explosives as a means of testing the integrity of large masses of metal and their resistance to shock.

Explosives Industry in the United States.— From the reports of the Twelfth Census of the United States it appears that in the last census enumeration there was produced 25,638,804 pounds of gunpowder; 977,442,237 pounds of blasting powder; 35,482,947 pounds of nitroglycerin; 3,662,633 pounds of cellulose nitrates; 85,846,456 pounds of dynamite, and 3,053,126 pounds of smokeless powder. The comparative condition of the industry from 1840 to 1905 is shown in the following table:

TOTAL PRODUCTION AND VALUE OF EXPLOSIVES IN THE UNITED STATES BY DECADES, 1840–1905.

	No. of establishments	Capital	Average No. of wage-earners	PRODUCTS	
				Pounds	Value
1840...	137	$875,875	496	8,977,348	....
1850...	54	1,179,223	579	....	$1,590,332
1860...	58	2,305,700	747	....	3,223,090
1870...	36	4,099,900	973	....	4,237,539
1880...	54	6,585,185	1,340	....	5,802,029
1890...	69	13,539,478	2,353	98,645,912	10,993,131
1900...	97	19,465,846	4,502	215,590,719	*16,950,976
1905...	124	42,307,163	5,800	....	29,602,884

* This value is for the explosive substances only. When materials of all kinds produced in these establishments are included, the value is $17,125,418.

The establishments reported for 1905 were most numerous in the sections where mining or engineering operations were carried on most extensively. Pennsylvania had 40 factories and the largest output was in the Middle Atlantic States; in fact, she alone manufactured over one fourth of the entire annual output, and was the largest producer in the United States. See DYNAMITE; FIRE-DAMP; GUNPOWDER; NITROGLYCERIN; MAXIMITE; STABILITE.

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Exports and Imports, American. The interchange of commodities among nations, a process now seen in its highest and most elaborate forms of development in the commercial relations between manufacturers, merchants, and financiers of the United States and those of other countries, owes its origin to the brave, enterprising adventurers of Southern Europe, France, Holland, and England, who, during the 14th, 15th, and 16th centuries, scoured the seas in quest of territory for occupation and the exploitation of trifling commercial ventures.

The motives of these men were not primarily patriotic as a rule, but they were, in the hands of Providence, to be the foundation-layers of a gigantic, world-wide commercial, political, and social structure such as now exists and is forever expanding.

The discovery and occupation of the Canary Islands, Madeira and the Azores; the doubling of the Cape of Good Hope by Vasco de Gama; the finding of Zanzibar and penetration eastward to the mainland of India; the crossing, thrice, of the Atlantic by Columbus; his landings at Jamaica and Porto Rico; the finding, by Cabot, of Newfoundland, Labrador, Nova Scotia, Virginia, and the present Canadian territory — these events, and such as these, gave an impetus to adventurous navigation that has continued without intermission and still dominates among expert sailors and explorers. Arctic and Antarctic expeditions are among the most modern illustrations of the Caucasian tendency to seek a further knowledge of the world's resources and hidden treasures.

The establishments, by Portuguese traders, of the first European factory in India, soon after the results of de Gama's expedition became known; the founding of the English East India Company and the explorations of Spain in Mexico and Peru were among the most important events leading, directly or indirectly, to a magnitude of commercial operations such as is now illustrated in the grand aggregates of United States exports and imports.

Portugal, figuring but little in 20th century commerce, at that time led the way in discoveries of subsequently profitable markets on the coast of Africa, in India, and in the Indian archipelago. Spain, now so trifling in stature among nations, in those days pervaded what might be termed the atmosphere of adventure and by her mining work in Central and South America greatly increased the world's available stock of precious metals. French activity in the East and West Indies, in Canada and in the Mississippi region helped to swell the tide of commercial progress. Dutch aggressiveness in New Amsterdam and English colonial development also contributed substantially to the general advance.

Conspicuous among events connected with the beginnings of New World commerce, which consisted principally of dealings in foodstuffs, metals, dyes, tissues, and chemical substances, was the importation of negroes, begun by Spain, in the early part of the 16th century. The employment of this class of forced-servitude workers into the West Indies was started by England in 1652. Then followed their introduction by landowners and others in New England and the Southern States.

The declaration of peace in 1783 found the United States occupying, as their only territory, the strip bordering the Atlantic from Maine to Florida. This territory was bounded on the west by the Mississippi River. Seven years later, with a total settled area of 240,000 miles and an aggregate population estimated at four millions, the principal commercial products were as follows:

Tobacco, grown in Virginia and Maryland and sent abroad to all countries.

Rice and indigo, grown in the Carolinas and highly esteemed in European markets.

Fish and lumber, products of New England and sold extensively in the West Indies, then European colonial possessions.

Furs. New York was the centre of the fur trade.

Agriculture. Agricultural industries were developing in the Northwest.

Commercial extension in the United States, from 1790, was brought about by annexation of territory west of the Mississippi and to the southward, including Florida and Texas. From the start, agriculture has furnished, and still furnishes, the bulk of United States exports, cotton, hog products, wheat flour, wood, animals, beef products, and wheat figuring as leading items, with an aggregate value of $786,000,000. Manufacturing, as a recognized feature of United States commerce and, consequently, an important division in the consideration of increasing exports and decreasing imports, began in 1816. The inventive genius of Americans, ever since that time, has aided and encouraged capital and enterprise in bringing American-manufactured products to the prominence now so universally accorded them. According to the Federal census returns of 1905 reported, in their completed form, 533,769 manufacturing establishments in the United States, employing $13,872,035,371 of capital owned by firms and companies. The number of wage-earners is given as 6,157,751, receiving $3,016,711,706 in wages. The total cost of materials is reported as nearly $9,497,619,851 and the value of products as over $16,866,706,985.

The American export trade, in spite of many fluctuations in financial, commercial, and political conditions, has shown a steady growth, unmarked by any startling decreases such as might reasonably have been expected as a result of panics, wars, labor troubles, and other disturbances, local, State, National, and international. During year ending June 1910, the exports of domestic merchandise from the United States amounted to $1,710,083,998. During 1879, 1882, 1884, 1885, 1887, and 1889 the total was between $700,000,000 and $800,000,000; during 1880, 1883, 1890, 1891, 1893-1896, it was between $800,000,000 and $900,000,000; during nine other years the total of exports has exceeded $1,000,000,000.

Exports from United States — Merchandise (not Specie).—The grand total of merchandise (not specie) exports, domestic and foreign, from the United States for the fiscal year ending 30 June 1909 amounted to $1,663,011,104. Ten of the largest of these aggregates are as follows: Cotton (unmanufactured), $417,390,665; iron and steel (manufactures of), $144,951,357; hog products, $144,432,322; mineral oils, $105,999,637; wheat flour, $51,107,366; wood (and manufactures of), $67,867,432; copper (manufactures of), $85,290,186; animals, $22,645,438; beef products, $20,817,149, and wheat, $68,094,447. The aggregate for the ten industries, 1909, as shown above, $1,098,647,999.

For fiscal year ending 30 June 1910, the same ten export aggregates as shown above were: Cotton (unmanufactured), $450,447,243; iron and steel (and manufactures of), $179,133,186; hog products, $41,227,000; mineral oils, $99,090,212; wheat flour, $47,621,467; wood (and manufactures of), $78,813,803; copper (manufactures of), $88,004,397; animals, $17,447,735; beef products, $13,975,519, and wheat, $47,806,598.

Imports to United States—Merchandise (not Specie).—Grand total of merchandise (not specie) imports into the United States during the fiscal year 1909 amounted in value to $1,311,920,224. The ten largest aggregates were as follows: Sugar, $96,554,998; coffee, $79,112,129; chemicals, drugs and dyes, $80,599,868; hides and skins other than furs, $78,487,324; manufactures of cotton, $62,010,286; silk (unmanufactured), $79,899,655; india rubber and gutta percha (crude), $64,710,370; fibres, vegetable (manufactures of), $49,312,392; fibres, vegetable (unmanufactured), $29,748,353, and silk (manufactures of), $30,718,582. The aggregate of the ten industries, 1909, as shown above, is $651,153,957. Considering only the ten classes of products outgoing and incoming, the excess of outgoing over incoming products, 1909, was, in round numbers, $447,500,000. A remarkable feature of the aggregate showing for 1904 under the two general headings shown above, including all industries and products, is that almost exactly the same proportion of excess in exports over imports, as revealed in ten products appears. (See table following.)

For the fiscal year ending 30 June 1910, the same ten import aggregates as shown above were: Sugar, $106,349,005; coffee, $69,194,353; chemicals, etc., $90,964,241; hides and skins, other than fur, $112,247,836; silk (unmanufactured), $67,105,177; india rubber and gutta percha (crude), $106,801,496; fibres, vegetable (manufactures of), $57,624,245; fibres, vegetable (unmanufactured), $32,418,839; silks (manufactures of), $32,888,459.

Exports and Imports, 1791-1910, *with Excesses of Each.*—The following table presents a compact view of United States exports and imports covering the period of 119 years. It will be noted that there has been a substantial excess of exports over imports each year since 1893.

TOTAL VALUES OF ALL EXPORTS AND IMPORTS, EXCEPT GOLD AND SILVER,† FROM 1800 TO 1910.

Year	Exports	Imports	Excess
1800....	70,071,780	91,252,768	Imp. 20,280,988
1810....	66,757,970	85,400,000	Imp. 18,642,030
1820....	69,691,669	74,450,000	Imp. 4,758,331
1830....	71,670,735	62,729,956	Exp. 8,940,779
1840....	123,668,932	98,258,706	Exp. 25,410,226
1850....	144,375,726	173,509,526	Imp. 29,133,800
1860....	333,576,057	353,616,119	Imp. 20,040,062
1870....	392,771,708	435,958,408	Imp. 43,186,640
1880....	835,638,658	667,954,746	Exp. 167,683,912
1890....	857,828,684	789,310,409	Exp. 68,518,275
1892*...	1,030,278,148	827,402,462	Exp. 202,876,686
1893**..	847,665,194	866,400,922	Imp. 18,737,728
1897*...	1,050,993,556	764,730,412	Exp. 286,263,144
1900....	1,394,483,082	849,941,184	Exp. 544,541,898
1901....	1,487,764,991	823,172,165	Exp. 664,592,826
1902....	1,381,719,401	903,320,948	Exp. 478,398,453
1903....	1,419,991,290	1,025,619,127	Exp. 394,372,163
1904....	1,460,868,185	991,090,978	Exp. 469,777,207
1905....	1,518,561,666	1,117,513,071	Exp. 401,048,595
1908....	1,860,773,346	1,194,341,702	Exp. 666,431,554
1909....	1,663,011,104	1,311,920,224	Exp. 351,090,880
1910....	1,744,984,720	1,557,819,988	Exp. 187,164,732

*Given because exports here passed the billion mark.
**Given because last year of excess of imports.
†Gold specie exported, 1904, $81,000,000; silver specie, $50,000,000.

Exports, Merchandise, 1909; *Value, by Principal Countries.*—The ten greatest values in merchandise sent from the United States during the fiscal year 1909 went to the following countries: Great Britain and Ireland, $514,627,365; Germany, $235,324,140; British North America, $169,633,823; France, $108,764,262; Netherlands, $95,012,366; Mexico, $49,793,323; West Indies, $64,886,401; Belgium, $45,093,003; Italy, $58,509,595, and British Australasia, $24,077,260. The aggregate value of merchandise sent to the ten countries given above is $1,365,721,538.

1910. Great Britain and Ireland, $505,552,871; Germany, $249,555,926; British North America, $222,600,634; France, $117,627,466; Netherlands, $84,937,878; Mexico, $58,193,704; West Indies, $74,467,116; Belgium, $41,116,585, and British Australasia, $27,696,557. The aggregate value of merchandise sent to the nine countries given above during the year ending 30 June 1910, was $1,401,748,737.

EXPORTS FROM THE UNITED STATES TO OTHER COUNTRIES.

Divisions	Value, 1800	Value, 1850	Value, 1910
Europe........	$41,000,000	$114,000,000	$1,138,914,551
North America.	27,000,000	25,000,000	305,520,069
South America.	*1,000,000	9,000,000	93,246,820
Asia..........	1,000,000	3,000,000	60,861,813
Oceanica......	14,000	208,000	50,890,087
Africa........	1,000,000	977,000	18,551,380

*1810.

Imports, Merchandise, 1909; *Value, by Principal Countries.*—The ten greatest values in merchandise received in the United States from other countries, in their order, during the fiscal year 1909 were: From Great Britain and Ireland, $208,612,758; Germany, $143,525,828; France, $108,387,337; Cuba, $96,722,193; Brazil, $98,053,229; East Indies, $63,907,896; British North America, $81,791,760; Japan, $70,392,722; Mexico, $47,712,214, and Italy, $49,287,894. The aggregate value of merchandise sent to the United States from the ten countries given above is $968,393,831.

1910. Great Britain and Ireland, $271,029,772; Germany, $168,806,237; France, $132,363,346; Cuba, $122,528,037; Brazil, $108,154,491; East Indies, $70,748,613; British North America, $98,015,930; Japan, $66,398,761; Mexico, $58,795,943, and Italy, $49,868,367. The aggregate value of merchandise sent to the United States from the ten countries given above during the year ending June 1910, was $1,146,709,497.

THE WORLD'S EXPORTS TO THE UNITED STATES.

Grand Divisions	Value, 1800	Value, 1850	Value, 1910
Europe.........	$47,000,000	$125,000,000	$806,271,380
North America..	32,000,000	24,000,000	306,767,486
South America..	*6,000,000	17,000,000	196,164,786
Asia...........	12,000,000	10,000,000	194,026,802
Oceanica.......	143,000	1,500,000	37,099,795
Africa.........	551,000	682,000	17,[illegible]89,739

*1830.

Exports from the United States, from Principal Ports.—In their order of value, the principal exports of the United States shipped to other countries, during the fiscal year 1910, follow: New York, $651,986,356; New Orleans, $140,376,560; Galveston, $173,178,992; Boston, $70,516,789; Baltimore, $77,381,507; Philadelphia, $73,266,343; Savannah, $63,428,155; San Francisco, $31,180,760; Puget Sound, $30,121,004; Mobile, $27,526,245, and Buffalo Creek, N. Y., $34,788,677. The increase for American ports, 1904 over 1903, was: New York, $1,000,000; Galveston, $40,000,000; Boston and Charlestown, $1,750,000; Baltimore, $1,000,000; Puget Sound, $250,000; Wilmington, N. C., $4,000,000.

Imports Received at Principal Ports of United States.—In 1910, the value of imports at principal ports was as follows: New York, $935,990,958; Boston, $129,006,184; Philadelphia, $89,253,451; San Francisco, $49,998,111; New Orleans, $55,712,027; Baltimore, $29,900,618. In addition to the imports of merchandise, gold valued at $43,339,905 and silver at $45,217,194 were imported in the fiscal year 1910. The increase in imports received for American ports, 1904 over 1903, was: San Francisco, $1,000,000; New Orleans, $5,000,000; Detroit, $165,000; Mobile, $100,000; Galveston, $300,000. The decreases were: New York, $18,400,000; Boston and Charlestown, $6,000,000; Philadelphia, $6,000,000; Baltimore, $7,500,000; Puget Sound, $1,000,000; Newport News, $2,000,000; Charleston, $400,000, and Portland, Me., $1,000,000.

Exports from United States by Classes.—The aggregates under several great headings in 1860 and 1906, respectively (the last year in which these particular classifications were made), are given below:

Agricultural exports....	1860, valued at...	$257,000,000
	1906, " "...	969,000,000
Mining exports........	1860, " "...	1,000,000
	1906, " "...	53,000,000
Forest exports.........	1860, " "...	10,000,000
	1906, " "...	69,000,000

Fisheries exports......	1860, valued at ..	$4,000,000
	1906, " " ...	8,000,000
Total value of domestic manufactures exported	1860, " " ...	40,000,000
	1906, " " ...	1,718,000,000

Exports and Imports, Cuba, Porto Rico, Hawaii, and the Philippines.— The following tabular exhibit is interesting as an example of progress through close commercial and political contact with the United States:

YEARS	Cuba	Porto Rico	Hawaii	Philippines
1888				
Exports from U. S.	$10,000,000	$2,000,000	$2,000,000	$166,000
Imports to U. S...	49,000,000	4,000,000	11,000,000	10,000,000
1899				
Exports from U. S	$19,000,000	$3,000,000	$9,000,000	$400,000
Imports to U. S...	25,000,000	3,000,000	18,000,000	4,000,000
1910				
Exports from U. S.	$46,339,198	$27,097,654	$20,560,101	$16,832,645
Imports to U. S...	109,407,613	32,095,897	46,183,265	17,317,897

Exports from United States, Increase during Decade.—The increase in total value of exports from the United States to Europe 1899–1909, as shown by comparison of totals for 1899 and 1909, was $210,153,228; to North America, $151,544,937; to South America, $40,901,778; to Asia and Oceanica, $21,430,539. To Africa there was a decrease of $1,558,990. The total increase in volume of outward trade of the United States to the geographical divisions shown above was about $425,000,000.

Exports and Imports, 1904, Compared by Same Principal Classes of Products.—The value of provisions exported from the United States, 1910, was $131,000,000; imported to the United States, $12,000,000; iron and steel (manufactures of), exported, $179,000,000; imported, $39,000,000; oils, exported, $116,000,000; imported, $24,000,000; animals, exported, $17,000,000; imported, $8,000,000; leather (and manufactures of), exported, $53,000,000; imported, $17,000,000; cotton (no manufactures of), exported, $450,000,000; imported, $16,000,000; coal (bituminous), exported, $26,000,000; imported, $4,000,000.

Exports, American Vessels.— The value of exports carried from the United States in American vessels 80 years ago (1830) aggregated $64,000,000. Twenty years later the records show $100,000,000. The official reports for 1910 give a total of $114,000,000.

Exports, Foreign Vessels.— Foreign merchantmen, in 1830, took from United States ports commodities valued at $10,000,000. The amount reached 1850, exceeded $52,000,000. The aggregate of exportations in foreign bottoms, 1910, showed values totaling $1,403,000,000.

Imports, American Vessels.—American vessels, in 1830, brought to the United States goods worth $66,000,000. This, after two decades, increased to $140,000,000. The latest official reports (1910), indicate $147,000,000 as the value, in that year, of imports arriving in American vessels.

Imports, Foreign Vessels.— The aggregate value of such imports, 1830, was over $4,000,000. In 1850, a grand total of more than $38,000,000 had been reached. The figures for 1910 under this heading show $1,319,000,000 as the amount represented for that year in imports brought in foreign ships.

Summary of Statistics.— The statements of fact, taken from official reports, following the introductory part of this article, show:

Exports from United States, merchandise and specie.

Imports to United States, merchandise and specie.

Exports and imports from 1791, with excesses of each.

Exports, merchandise, value of, by principal countries.

Imports, merchandise, value of, by principal countries.

Exports from United States, from principal ports.

Imports received at principal ports.

Exports from United States by classes.

Exports and imports, *Cuba*, Porto Rico, Hawaii, and the Philippines.

Exports from United States, increase during decade.

Exports and imports, compared by principal classes of products.

Exports, past and present, in American and foreign vessels.

Imports, past and present, in American and foreign vessels.

Comparison of United States Exports with the Exports of Principal Nations.— The ten countries showing the greatest total value of exports from their own territory are: United States, $1,492,000,000; United Kingdom, $1,463,000,000; Germany, $1,243,000,000; France, $864,000,000; Netherlands, $797,000,000; Russia, $516,000,000; British India, $500,000,000; Austria-Hungary, $424,000,000; Belgium, $421,000,000; Italy, $312,000,000.

Comparison of United States Imports with the Imports of the Principal Nations.— United Kingdom, $2,682,000,000; Germany, $1,515,000,000; United States, $991,000,000; Netherlands, $1,118,000,000; France, $876,000,000; Belgium, $537,000,000; Austria-Hungary, $416,000,000; Italy, $359,000,000; Russia, $351,000,000; British India, $314,000,000.

Conclusion.— The exports of any country furnish a reliable indication of its productive capacity. The three countries having the greatest productive capacity are, in their order, the United States, the United Kingdom (Great Britain and Ireland) and Germany, with France and the Netherlands holding creditable fourth and fifth places.

Imports show, approximately, the ability and necessity of a nation to buy. In the figures it will be noted that Great Britain and Ireland are the largest buyers, Germany being second, and the United States third. Accordingly the trade balance is most favorable to the United States.

Exports and Imports of the Latin-American Republics. *Argentina.*—The total value of exports from the Argentine Republic to all other countries during the year 1902 was $179,486,727 gold; an increase of $11,760,625, as compared with the exports in 1901; and the imports aggregated only $103,039,256 gold; a decrease of $10,920,493, as compared with those of 1901. Imports during 1902 from the United States into the Argentine Republic were: Agricultural implements, valued at $2,381,735; carriages, $412,033; cycles, $10,710; cotton cloths, $77,821; wearing apparel, $214,853; electric and scientific apparatus, $110,915; builders' hardware, $232,464; sewing-machines, $129,600; steam-engines, $8,380; typewriting-machines, $24,940; leather, $56,901; rosin, tar, etc., $136,958; turpentine, $124,161; oils, $1,132,402; lard, $5,040; tobacco, $17,213; wood, $54,098; lumber, $858,888; furniture, $98,220. Imports into the Argentine Republic from Great Britain during 1902 were: Cotton manufactures, valued at $5,776,336.22; jute manufactures, $229,104.28; linen piece goods, $269,452.23; woolen tissues, $601,887.91; worsted tissues, $798,908.89; carpets, $158,440.58; cutlery, $74,126.21; hardware, $99,830.13; iron (bar, bolt, etc.), $131,548.44; railroad iron, $1,956,566.33; wire (of iron or steel), $298,516.23; galvanized sheets, $1,354,663.55; tin plates and sheets, $3,669.54; wrought and cast iron, $1,044,020.86; cement, $147,483.08; earthen- and china-ware, $163,391.48. The distribution of exports and imports is shown in the following table:

Exports from Argentina to	Value in Argentine gold	Imports into Argentina from	Value in Argentine gold
Great Britain..	$35,084,066	Great Britain..	$36,995,460
France	29,587,457	France	9,243,071
Germany	22,939,881	Germany	13,229,275
Belgium	13,760,219	Belgium	5,484,233
United States ..	10,037,576	United States..	13,303,504
Brazil	8,368,742	Brazil	4,583,645
Africa	8,285,387	Africa	
Italy	4,215,756	Italy	12,265,003
Uruguay	3,673,633	Uruguay	744,694
Netherlands ...	2,834,288	Netherlands ...	622,359
Spain	2,025,428	Spain	3,166,902
Chile	684,113	Chile	213,189
Bolivia	600,368	Bolivia	122,015
Cuba	470,991	Cuba	106,781
Paraguay	212,212	Paraguay	1,469,510
Other countries	10,196,675	Other countries.	1,485,124
Orders	26,509,935		

Among the articles exported to the United States in 1902 were: 224 tons of tasajo (jerked beef); 800,000 pounds of bone and bone ash; 11,020 tons of wool; 966 tons of wheat; and 14,113 tons of linseed. Exports to Great Britain during that year were: Wheat, valued at $7,129,589.47; maize, $17,287,180.23; fresh beef, $8,414,574.84; fresh mutton, $11,069,641.49; unrefined sugar, $1,483,634.44; wet hides, including shipments from Uruguay, $737,975.45; linseed, $8,681,643.18; tallow and stearin, $3,290,318.10. The total shipments of wheat from Argentina in 1902 were estimated at 700,000 tons, and the exports of butter (5,837,282 pounds) were nearly four times as large as those of 1901.

Bolivia.— The exports during 1902 were valued at $13,566,734, against $13,621,237.56 in the year 1901. Importations from all countries into Bolivia, according to consular invoices (values as given to the customs officers), amounted to $6,120,113, and to 16,953,223.75 *bolivianos,* or $6,476,131.47 United States currency, in 1901 and 1902. Exports from Bolivia consisted chiefly of silver, rubber, tin, and copper. Imported articles were bought principally from Germany, England, France, and the United States.

Brazil.— During the year 1902 Brazil exported to the United States coffee to the value of $47,004,453; india rubber, $15,209,295; sugar, $2,534,760; and cocoa, $1,302,493. Her imports from the United States in the same year were: Agricultural implements, valued at $35,702; wheat flour, $2,209,881; carriages, $54,266; cycles, etc., $6,799; cotton cloths, $603,161; wearing apparel, $81,143; electric and scientific apparatus, $323,941; builders' hardware, $188,404; sewing-machines, $74,114; steam-engines, $133,759; typewriting-machines, $12,428; leather, $155,119; rosin, tar, etc., $226,676; turpentine, $79,804; oils, $2,568,684; beef, $9,926; tallow, $26,905; bacon, $167,981; hams, $2,612; pork, $13,021; lard, $924,582; butter, $116,410; lumber, $353,175; and furniture, $16,639. Exports from Brazil to Great Britain in 1902 were: Raw cotton, valued at $5,299,665.49; coffee, $2,290,862.61; unrefined sugar, $932,001.12; wet hides, $271,850.49. Imports from Great Britain were: Coal and coke, valued at $3,687,880.53; cotton manufactures, $6,845,427.84; jute yarn, $1,787,220.33; jute manufactures, $93,148.49; linen piece goods, 246,509.66; woolen tissues, $401,940.58; worsted tissues, $490,652.50; cutlery, $147,826.77; hardware, $135,634.37; iron (bar, angle, bolt, and rod), $155,933.05; railroad iron, $597,315.24; iron- or steel-wire, $60,329.56; galvanized sheets, $205,820.55; tin plates and sheets, $372,900.77; wrought and cast iron, $890,377.75; cement, $55,513.13; earthen- and china-ware, $307,160.64; and seed oil, $295,657.70. There was a marked increase in exports to Spain and France. The aggregate of exports to all countries during the first six months of 1902 was $84,291,922.61; while the imports from all countries during the same period amounted only to 219,886 *contos,* or $52,971,457.52.

Chile.— Exports to all countries during the first half of the year 1902 had an aggregate value of $93,955,450, including gold and silver specie; or $79,745,933, excluding specie. In the corresponding period of 1901 the value of the exports was $78,682,883, including gold and silver specie, amounting to $203,119. The total value of imports in the first half of 1902 was $63,158,537; that sum being less by $2,608,044 than the imports during the corresponding period of 1901. It is stated that the diminution is due to the following causes: «In the first place, there are the rectifications made in the valuations of sugar, coffee, and tea. In the statistics for 1901 these articles figured with an excess of $3,652,000 over their real value. In the second place, the last harvest sufficed for the wants of the country, and consequently there were no heavy imports of wheat and flour, which articles in 1901 represented a value of $8,578,000. In the third place, there was the higher premium on gold, and transitory circumstances which perturbed trade and reduced personal consumption.» Instead of importing wheat, as in 1901, Chile sent more than 15,000 tons of that product to Peru. Imports from the United States during the entire year 1902 were: Agricultural implements, valued at $132,242; carriages, cars, etc., $115,276; cotton cloth, $520,642; wearing apparel, $29,311; electric and scientific apparatus, $52,979; builders' hardware, $123,116; leather, $28,398; rosin, tar, etc., $15,593; turpentine, $34,105; oils, $554,080; beef, $7,493; tallow, $3,020; lard, $42,681; wood, $5,371; lumber, $199,183; and furniture, $14,844. Imports into Chile from Great Britain during 1902 were: Cotton manufactures, valued at $3,065,788.29; woolen tissues, $520,422.81; worsted tissues, $810,723.76; carpets, $121,409.10; cutlery, $65,384.62; hardware, $102,771.61; iron (angle, bar, bolt, and rod), $166,554.00; railroad iron, $181,173.74; galvanized sheets, $378,598.67; and wrought and cast iron, $171,163.62. Exports from Chile to Great Britain in 1902 were principally nitrate of soda and copper (namely, copper ore, $1,419,224.76; regulus and precipitate, $1,226,558.20; and wrought and unwrought copper, $4,452,300.10). British importations of nitrate of soda during 1902 had a total value of $5,122,606.90, most of which came from Chile. The British empire (on account of the business done with India) heads the list of importers, and Germany stands next in order.

Colombia.— According to official statistics of the United States, Colombia imported from this country in 1902: Agricultural implements, $3,553; wheat flour, $231,828; carriages, $21,675; cycles, $937; cotton cloths, $1,286,535; wearing apparel, $76,398; builders' hardware, $55,667; sewing-machines, $19,129; steam-engines, $21,400; typewriting machines, $3,227; leather, $14,297; boots and shoes, $80,514; rosin, tar, etc., $11,705; turpentine, $5,802; oils, $115,884; beef, $27,310; tallow, $3,880; bacon, $2,971; hams, $15,444; pork, $14,133; lard, $109,952; butter, $13,626; cheese, $10,960; tobacco, $70,869; wood, $12,718; lumber, $36,992; and furniture, $24,327. Imports into Colombia from Great Britain during the same year were: Cotton manufactures, $3,129,788.29; and linen piece goods, $60,595.52. The only available commercial statistics of a Colombian source are those of the port of Cartagena. The total value of imports there during 1902 is given as $1,601,159.28 United States gold. Reliable statistics of exports in 1902 cannot be obtained.

Costa Rica.— Exports of coffee (1 Oct. 1901 to 30 Sept. 1902) amounted to 236,057 sacks. Exports of bananas in 1902 were greater than in any preceding year — 4,174,199 bunches, worth, approximately, $1,878,389.55. Other exports in 1902: cocobola logs, valued at $7,187.04; fustic (*palo mora*), $43,514.28; mahogany, $2,487.60; cedar timber, $117,007.80; cacao, $24,051.20; sundry merchandise by parcels-post, $8,934.67; gold by parcels-post, $11,630.63; total gold and silver coin and bullion, $147,340.59; not enumerated, $41,184.44. Imports into Costa Rica from the United States in 1902 were valued at $2,048,809; that sum being 54 per cent of the total value of Costa Rica's imports, which was $3,794,642. Great Britain furnished 24 per cent of the imports, Germany 12½ per cent, and France a little over 5 per cent. The chief imports from the United States were foodstuffs, machinery, and tools, cotton prints, dynamite, drugs, paints, and oils. Foodstuffs of European origin were imported to the value of $118,329 in 1901, but only $87,675 in 1902, while similar imports from the United States increased from $493,078 in 1901 to $554,251 in 1902. This increase is due to frequent and easy maritime communication with the ports of New York, New Orleans, and Mobile, which has also "raised the percentage of Costa Rican products shipped to the United States, such as gold bullion, rubber, hides, and coffee." From Nicaragua 14,587 head of cattle were imported. Imports of gold coin in 1902 amounted to $250,000, of which $150,000 was consigned to the government and $100,000 to the Bank of Costa Rica.

Cuba.— The principal exports from Cuba to the United States in 1902 were sugar, tobacco, bananas, mahogany, and logwood. Imports into Cuba from the United States were: Wheat flour, valued at $2,059,876; agricultural implements, $45,304; corn, $827,538; carriages, $457,217; cycles, $12,320; cotton cloths, $208,039; wearing apparel, $158,313; builders' hardware, $322,500; sewing-machines, $97,355; steam-engines, $125,730; typewriting machines, $33,982; leather, $68,348; rosin, tar, etc., $28,576; turpentine, $30,154; oils, $586,946; beef, $9,105; tallow, $7,276; bacon, $379,188; hams, $505,757; pork, $316,383; lard, $2,197,928; butter, $26,624; cheese, $14,593; tobacco, $137,339; wood, $151,614; lumber, $877,880; and furniture, $261,683. Cuba's exports to all countries in 1902 were valued at $64,329,000, an increase of $1,051,000, as compared with those of 1901. The United States took 76 per cent of the exports, $49,498,000, an increase of $1,431,000 over 1901; England 9 per cent, $5,087,000, a decrease of $134,000; Germany 6 per cent, $3,967,000, a decrease of $272,000; Spain 2 per cent, and France 1 per cent. The island produced 880,000 tons of sugar in 1902–3; or nearly 30,000 tons more than in 1901–2; yet the value of the sugar exported in 1902 was less by $1,391,000 than in the preceding year. Tobacco exported in 1902 was valued at $25,404,000, an increase of $77,000. See CUBA.

Dominican Republic.— During the year ending 30 June 1902, exports to all countries amounted to $3,095,691.43. Those to the United States were valued at $2,500,000, and imports from the United States at $1,500,000. See DOMINICAN REPUBLIC.

Ecuador.— For the year ending 30 June 1902 trade with the United States was represented by exports valued at $1,500,000, and imports $1,400,000. See ECUADOR.

Guatemala.— Exports to the United States during the fiscal year ending 30 June 1902 were valued at $2,600,000; imports from the United States, $1,680,000. See GUATEMALA.

Haiti.— The value of exports to the United States during 1902 is given as $1,200,000; of imports from the United States, $2,700,000. The principal articles exported were coffee, cocoa, and logwood. Haiti imports from Great Britain considerable quantities of cotton and linen goods and hardware.

Honduras.— The total value of exports from this republic in 1902 was $6,170,353.27, a decrease of $12,670.10 as compared with 1901. But during the past four years Honduras has increased the value of her exports by $1,387,666.69, and the value of her imports by $2,777,161.42. The total value of imports during 1902 was $4,377,161.42. The United States took two thirds of the exports ($4,077,108.89), and supplied three fifths of the imports ($2,841,484.10). Other countries to which exports were sent: Great Britain, $778,293.60; Central American republics, $775,473.90; Cuba, $303,509; Germany, $136,214.54. Metals valued at $938,976 (23,235 ounces of gold, 1,010,204 ounces of silver, and 25,198 ounces of copper) were exported during the year. (In this paragraph the dollar mark means *peso*, standard "dollar" of Honduras; value $0.39 in 1892.)

Mexico.— The exports from Mexico for the fiscal year ending 30 June 1902 were valued at $156,168,145.66 silver. In the preceding year the amount was $148,659,001.71 silver. The largest items were precious metals, to the value of $68,897,126.17 in 1901–2; and of $81,376,319.78 in 1900–1. The imports form a study of special interest to American business men, as indicated in the following table:

IMPORTS OF MEXICO (VALUES GIVEN IN GOLD).

Source	Fiscal Year 1900–1901	Fiscal Year 1901–1902
North America	$35,201,400.35	$37,450,613.84
Europe	28,956,971.89	26,380,111.76
Asia	545,410.29	514,309.08
Africa	26,938.62	25,030.06
Central America	70,044.75	41,091.93
South America	140,212.27	156,101.38
West Indies	58,009.00	53,851.65
Oceania	84,466.12	35,239.73
Total	$65,083,453.29	$64,656,349.43

But Mexico's imports from the United States were valued at $35,189,955.85, in 1900–1; and at $37,435,099.29, in 1901–2, being nearly the entire amount credited in the table to North America: this statement may, therefore, be regarded as evidence of a decided improvement in the commercial relations of the United States with Mexico. European countries which supplied Mexican imports in the fiscal year 1901–2 were: Germany, to the value of $6,451,099.24; Austria-Hungary, $354,401.75; Belgium, $1,074,743.17; Spain, $2,719,909.77; France, $6,296,001.72; Great Britain, $8,266,096.33; Holland, $235,246.35; Italy, $397,450.06; Norway, $79,056; Portugal, $41,265.45; Russia, $3,062.83; Sweden, $49,789.77; Switzerland, $405,811.53; other countries, $16,177.25. Imports during the last six months of 1902 from all countries were valued at $36,973,133 gold; against $29,586,547 for the same period of 1901. Exports also increased, being valued at $93,254,675 silver for the last six months of 1902; or $19,990,745 silver more than for the corresponding period of 1901. Exports from Mexico to the United States during the calendar year 1902 were: copper, value in United States gold or silver, $14,373,820; coffee, $2,785,633; coal, $25,022; logwood, $18,206; sisal grass, $12,907,629; oranges, $90,534; hides and skins, $3,611,628; india rubber, $97,534; lead, $3,884,285; sugar, $8,624; tobacco leaf, $61,595; and mahogany, $394,720. Imports from the United States during the calendar year 1902: agricultural implements, value in United States gold or silver, $340,514; corn, $4,275; wheat, $59,551; wheat flour, $217,485; carriages, $1,429,573; cycles, $27,052; copper, $829,035; cotton, $3,142,223; cotton cloths, $219,476; wearing apparel, $439,032; electric and scientific apparatus, $852,373; iron and steel, $427,192; builders' hardware, saws and tools, $765,317; sewing-machines, $422,845; steam-engines, $1,099,806; typewriting machines, $163,521; leather, $13,573; boots and shoes, $680,607; rosin, tar, etc., $16,558; turpentine, $3,415; oils, $1,543,776; beef, $20,566; tallow, $30,990; bacon, $32,754; hams, $61,932; lard, $533,365; butter, $86,160; cheese, $50,288; tobacco, $242,666; wood, $611,161; lumber, $1,509,983; and furniture, $613,608. Imports into Mexico from Great Britain in 1902 were: cotton manufactures valued at $1,506,379.24; linen piece goods, $70,595.52; railroad iron, $1,556,008.83; and galvanized sheets, $405,695.35. Importations of textiles and woven goods were less in value by $843,755.48, as a result of the increased manufacture of such goods in the Mexican mills.

Nicaragua.— Exports to the United States for the year ending 30 June 1902 were valued at $1,900,000; imports from the United States during the same year, $1,300,000. The total amount of foreign merchandise imported into Nicaragua during 1902 was said to be considerably less in quantity and value than that of any of the preceding 10 years. British trade with this republic has declined, or has been transferred to the United States or Germany. Mahogany logs, shipped from the port of Bluefields in 1902, represented 6,759,325 feet of lumber, valued at $337,966 United States currency.

Paraguay.— Exports, during 1902, were valued at $3,252,650 gold; imports at $2,050,000 gold, 35 per cent less than in 1901. Exports to the Argentine Republic in 1902 amounted to $1,469,510, and imports from that country to $1,681,722. See PARAGUAY.

Peru.—In the first half of the year 1902 imports amounted to $7,391,681. Ores to the value of $8,526,632 were exported; the value of such exports in the previous year having been $8,259,319. Exports to the United States in the year ending 30 June 1902 were valued at $3,200,000; imports from the United States at $2,500,000. Exports to Great Britain in 1902 were: unrefined sugar, valued at $278,276.34; alpaca, vicuña, and llama, $1,266,144.49; copper regulus and precipitate, $661,399.57. Imports into Peru from Great Britain during 1902 were: Cotton manufactures to the value of $1,785,751.08; woolen tissues, $356,985.61; worsted tissues, $125,285.62; railroad iron, $225,541.01; and wrought and cast iron, $171,063.62.

Salvador.— Exports in 1902 were valued at 10,278,151.98 *pesos*, and imports at 2,747,385.08 *pesos;* value of a *peso* in United States gold or silver being $0.384. The imports were chiefly from Great Britain, the United States, and Germany. In the fiscal year ending 30 June 1902, exports to the United States amounted to $600,000; and imports from the United States to $890,000. Coffee was exported to Austria, Holland, and Norway; sole leather to Cuba; manufactured tobacco to Curaçao; indigo to Chile, Ecuador, and Peru; and to Spain, Salvador sent indigo, coffee, and manufactured silk.

Uruguay.— The exports in 1902 were valued at $32,549,483; and the imports at $23,757,471. During the six years from 1897 to 1902, the exports of this republic exceeded the imports by $44,485,150. Exports to the United States, during the fiscal year ending 30 June 1902, were valued at $2,500,000; and imports from the United States at $1,500,000. Imports into Uruguay from Great Britain during 1902 were: Cotton manufactures, to the value of $2,097,426.21; woolen tissues, $128,105.35; worsted tissues, $213,843.11; iron (bar, angle, bolt, and rod), $48,641.56; railroad iron, $16,071; and galvanized sheets, $215,770.22.

Venezuela.— Exports through Puerto Cabello in 1902 were: 374,786 cattle hides; 11,205 deerskins, and 70,053 goatskins; the United States being the principal purchaser. Imports into Venezuela from the United States in 1902 were: Agricultural implements, valued at $1,694; carriages, $13,620; cycles, $462; cotton cloths, $460,888; wearing apparel, $17,328; electric and scientific apparatus, $28,320; builders' hardware, $22,682; leather, $27,406; rosin, tar, etc., $20,341;

turpentine, $3,488; oils, $108,870; hams, $31,154; lard, $298,888; butter, $84,363; lumber, $1,946; and furniture, $8,555. Cotton manufactures to the value of $911,440 were imported during 1902 from Great Britain. Complete statistics were not prepared owing to the disturbances in the country. A statement of the foreign commerce during other years will be found in the article VENEZUELA.

Consult: 'Monthly Bulletins' of the International Bureau of the American Republics from July 1902 to July 1903, inclusive.

MARRION WILCOX.

Express Service. The creation and development of express service in the United States, and the extension of the American express system, under American control, throughout the length and breadth of the civilized world, and beyond, offers positive, convincing proof of unique native constructive and administrative genius along the lines of greatest utility to mankind.

One of the most prominent, successful, and progressive express companies, now operating on every continent, began, some sixty years ago, with a simple service for delivery of packages between a few eastern and western points. To-day, the same organization has, in addition to traffic in the United States, British North America, and the Latin-American republics, at least a dozen agencies with commodious quarters on leading thoroughfares in principal European cities, each fully equipped with men, wagons, and horses for the most rapid and effective express service.

As part of its routine business, the company is in touch with thirty of the world's largest banking institutions and has shipping and banking correspondents at all large cities and ports in both hemispheres. As a means of comparison with express conditions of half a century ago, when the system was merely an adjunct to the railroads, a brief outline of the work now being carried on in progressive express companies will be of interest. Since the express plan first began, in 1838, the situation of the railroads toward the express companies has, by mutual consent, and to meet ever-growing demands, been entirely reversed. The railroads, in their own interests, so far as carriage of express freight is concerned, are now adjuncts of the express companies.

The most modern American express service, when conducted on a large scale, usually includes, in addition to conveyance of ordinary merchandise packages, the following special features:

Travelers' cheques, letters of credit, sight drafts, money orders, money transfer by cable and telegraph, payment of taxes, dues, etc., for nonresidents, conveyance of valuables and securities, collection of accounts, collection of notes, drafts, and C. O. D. parcels, purchase of goods, household supplies, books, articles, or commodities, rare or otherwise, and the performance of every other legitimate commercial, financial, or other transaction requiring the service of a personal representative of intelligence and discretion.

The "cheque" system has been so perfected that travelers in foreign countries save time and avoid delay by their use, as they are promptly recognized and cheerfully cashed or accepted by the principal hotels, steamship and sleeping-car companies, by many railroad companies, and by merchants, shopkeepers, and others, in settlement of accounts. Travelers often avoid loss of time in specially visiting banks to obtain funds for such expenses, as well as the delays resulting from inability to obtain money on Sundays, holidays, or fête days, or before or after business hours.

For those traveling in the United States, Canada, Mexico, Central and South America, these cheques afford the advantages of a secure and convenient means of carrying funds immediately available, combined with the avoidance of delays, of the risk of loss of money by fire or destruction, and of the annoyance of negotiating personal checks in places where such may be unacceptable. Being cashed by agents of the companies and by banks in all the principal cities and pleasure resorts of the United States, the Canadas, Mexico, Cuba, Central and South America, accepted in payment of fares by the principal steamship companies and many railroad companies throughout the United States, and received by agents and conductors of the Pullman Palace Car Company and by many hotels in settlement of account, travelers cheques are found to be a most satisfactory form of credit for use during a tour.

"Letters of Credit" now form a usual express office specialty. These documents are drawn in sterling and are available in all parts of the world. Through the Letters of Credit system, cheques may be obtained from express agencies at all important points. Every foreign express correspondent has a cable address, also every express agency.

The "C. O. D" system and bank of account collection are among the useful developments of express service. "C. O. D." shipments are subject to collection of bill or invoice for the goods, with prompt return of proceeds made at a small charge for such service. C. O. D. shipments to foreign countries are usually made under the same system as applied to domestic points.

Several of the big express companies attend to the collection of accounts, bills, notes, drafts, etc., in any part of the commercial world. Collections in United States and Canada are effected with unusual promptness and at less risk and cost to payee than by other methods. Collections in foreign countries of drafts or deposits, or by powers of attorney, are undertaken by express companies through their own organizations in Europe or through banking correspondents. The proceeds of C. O. D.'s or collections are transferred by cable when patrons desire, with a charge for collecting, plus only the cost of cablegrams.

The transfer of money is another useful and much appreciated feature of express service. Purchases are made and commissions executed for patrons, in the quickest possible time, at places in United States, Canada, and Europe, by a special department. Besides attending to orders for the purchase or sale of goods and property, including household supplies, this department pays tax bills, redeems articles pawned, collects baggage at railroad stations, secures seats at theatres, berths on sleeping cars, staterooms on steamboats, passage and staterooms on European steamers. Rare goods or books or articles requiring exact matching, or the maker or seller of which is unknown, are obtained without annoyance or loss of time to patrons.

Imports and exports of every class and size are handled by express companies now, as a rule, this work being deemed part of their regular business. Bills of lading, bills of exchange and all other documents of that character are prepared and attended to from first to last.

Money orders and drafts are issued by several express companies for any amount, at the posted rate of exchange, in sterling, francs, lire, lei, marks, kroner, rubles, kronen, gulden, finmarks, Turkish pounds, Mexican dollars, local dollars, pesos, rupees, yen, and U. S. dollars on all parts of the commercial world.

The regular transportation service of express companies includes merchandise, parcels, produce, money, bonds, valuables, and baggage. The routes extend over 50,000 miles of railroads in the United States alone. Shipments are frequently made in through express cars, with burglar and fire-proof safes for valuables and iron express trunks for parcels, all in charge of special messengers, fully armed. The swiftest trains are almost invariably used for express service. The aim of the companies is to cover the ground in the least time at the lowest rates. They accept entire responsibility for loss or damage. Some express companies run special express trains to facilitate business during very busy seasons. Other companies have this feature as a permanent arrangement.

Novel and highly useful features of the most modern express service are the securing of ocean passages, European railroad tickets, and passports for patrons at a nominal charge. It is only necessary for those who desire to utilize express companies in this way to state their wishes — the companies do the rest rapidly, perfectly, and inexpensively.

So much for the work-scope of express companies to-day as compared with that of earlier periods. Before reviewing briefly the evolutionary processes connected with express service developments it may be well to mention what has been brought about through the use of express enterprise and by such methods as are peculiar to the service.

1. The creation of wagon service, and, in connection with this, special cars and trains for transportation of express matter at high speed.

2. The creation of transportation business for carriage to and from all advantageous producing points of game, poultry, fish, oysters, and fruit to localities where these commodities are not easily obtainable.

3. The creation of a novel method of selling goods for merchants by collecting on delivery the amount of invoice and returning cash to the shipper.

4. The creation of a method of collecting the proceeds of negotiable paper and assuming, for the time being, responsibility of indorsees.

5. The creation of an efficient means of safe transportation of moneys and valuables shipped by individual citizens and by firms, banks, railroads, and the government. In one year $4,000,000,000 have been shipped in the United States through the express companies in this manner.

6. The creation of a vast and perfect network of money-order agencies. The present number of these agencies is estimated at 40,000.

The creation of improved facilities for immediate transportation of foreign goods from ports of entry to destination. Heavy bonds are demanded by the government and given for proper execution of this service.

Origin and Evolution of the Express Idea.— The «Express» idea sprang from the system of sending parcels in care of coach-drivers, by stage-coach, and from the shipping of such parcels in care of captains, by coasting vessels.

When the railroads took the place, gradually, of the coaches, much parcel traffic was performed by means of the steam-cars. Then the conductors of these cars had to assume responsibility for safe-keeping. Eventually, this transfer overcrowded them with work. A division of duties naturally followed. Finally, the railroads insisted that their employes should chose between railroad and the supplemental delivery traffic.

The principal events following this decision were:

1838–9. The starting of an express company to operate in New England. Alvin Adams, who later began business for himself in New York, was with this company.

1839. «Harnden's Express» started between New York and Boston.

1840. «Adams' Express» began operations between the same points.

1840–45. Other expresses opened up business, extending service to Philadelphia, Baltimore, Washington, Buffalo, Pittsburg, Detroit, Chicago, Cincinnati, Louisville, St. Louis, and New Orleans.

The men most active in the new field at this time were William F. Harnden, William B. Dunsmore, Henry Wells, Edward P. Sanford, Samuel M. Shoemaker, Johnston Livingston, and William G. Fargo.

Almost all of the western transportation was carried on over the Ohio, Mississippi, and Missouri rivers, with their tributaries, which included canals then recently completed in several of the States to connect those rivers with the lakes.

From 1840 the construction of railroads continued uninterruptedly, express business expanding in proportion. Then came the inauguration of express «continuous lines,» enabling goods to be carried quickly between many points without transfers.

At this period people sent their letters by express as being safer than the government's mail service. In course of time the authorities at Washington protested, and finally prohibited by law the private conveyance, without United States contract, of private letters.

1848. The stampede of gold-seekers, 1848–9, to California, brought out a great extension of the express system. Money and gold-dust were transmitted direct from the coast to eastern points through the express companies, many new agencies being established for the purpose.

1854. In this year a consolidation of express interests took place. «Adams & Co.» bought up and worked several minor eastern routes and secured the right to much southern traffic.

During the same year the «American Express Co.,» first established in 1841, was formally organized, to operate from the east to the far west.

The «United States» express also came into existence in 1854 to operate along the New York & Erie railroad and the route running westward.

1854–5. About this time «Wells, Fargo & Co.» were organized. They started the famous «Pony Express» and several stage lines. Other firms competed in these special forms of rapid transportation.

1855. The «National» Express Co. began operations in this year, with routes between New York, Albany, Troy, Saratoga, Whitehall, Rutland, and Montreal.

1858. Wells, Fargo & Co. and the Pony Express lines organized the «Overland Mail Co.,» which, until the completion of the Union Pacific railroad, carried the whole of the United States mails between the Missouri river and the Pacific coast. By this time the express had become a recognized necessity in the commercial and individual transactions of the country. Its lines had amplified in every direction. It had attracted to itself sufficient capital to place it on a firm financial basis. Obligations to insure the safe and speedy transmission of merchandise, valuables, and money were readily assumed. When loss or damage occurred, due reparation was promptly made. Thieves were and are, to-day, followed up by them until caught and punished.

1861. Henry S. Plant and associates organized the «Southern Express Co.,» which operated principally in the southern States.

1861–5. Upon the breaking out of hostilities, the express was the only means of communication between soldiers in the field and their friends at home. Government securities, being purchased largely by the people, were sent by government through the express, it being officially recognized that, during that critical period, the express was much safer than the official mail service.

After the war a contract was made by the United States government with the Adams Express Co., acting for itself and other companies, to transmit all securities and moneys of the government by express.

1865-1910. This period represents a phenomenal growth of the express movement. The present organization of the great companies, each with the experience of half a century to guide it, is practically perfect in its workings and labors continuously at high tension to keep even pace with calls which increase day by day. As railroad and steamship facilities become more and more complete the pressure becomes greater.

The routes now aggregate over 250,000 miles. The total number of packages handled per annum has reached nearly 150,000,000. The estimated total of men employed is 75,000, with 20,000 horses, and 10,000 vehicles. The annual incomes from operation of the 4 principal companies in the U. S. now aggregate $102,500,000.

Expressed Oils, in chemistry, oils obtainable from bodies by pressing, to distinguish them from mineral and essential oils, which last are obtained by distillation.

Expulsion. Usually this word is used to describe the act of depriving one or more members of a political or corporate organization, or of a society, of their right of membership. The act is frequently brought about by a vote of the organization or society after the submission of a committee report, for some violation of duty or some other offense rendering such member or members, in the opinion of their associates, unfit or unworthy.

It is provided in the Constitution of the United States that the members of the Senate or House of Representatives may expel members of their respective bodies, by a two-thirds vote, for disorderly conduct.

Corporations have the right of expulsion in cases where good order and proper control make the exercise of such power essential as, for example, (1) when the offense is not within corporate duties, but nevertheless disgraceful or infamous, or (2) when the offense is against his duty as a corporation member or officer or director, or (3) when the offense is of such a character as to infringe corporation rules and the statutes at the same time.

Before a person can be expelled from a corporation or society for disgraceful conduct outside of the jurisdiction of such organizations, a previous conviction by jury is necessary before expulsion. If the offense is against or in violation of corporation or society rules or duties, a trial and conviction may be had before the authorities of the organization.

The word «expulsion» is also used to describe the ejection of people from meetings when they create a disturbance or otherwise make their presence obnoxious. Those who convene meetings have, in the eyes of the law, the right to expel objectionable persons, providing they only use as much force as is necessary for the purpose.

Club members are not liable to expulsion for striking fellow members, refusing to submit to arbitration, refusing to pay awards of arbitration, or refusal to pay dues after illegal suspension.

Non-members of any organization, if present at any meeting of such organizations, are liable to expulsion.

The Constitution of the United States provides that Federal judges cannot be expelled from their posts during good behavior. See DISFRANCHISEMENT.

Expunging Resolution. See CENSURE, CONGRESSIONAL.

Extension, in physics and metaphysics, that property of a body by which it occupies a portion of space. Extension is an essential as well as a general property of matter, for it is impossible to form a conception of matter however minute may be the particle, without connecting with it the idea of its having a certain bulk and occupying a certain quantity of space. Every body, however small, must have length, breadth, and thickness; that is, it must possess the property of extension. Figure or form is the result of extension, for we cannot conceive that a body has length, breadth, and thickness without its having some kind of figure, however irregular. In logic, extension is the extent of the application of a general term, that is, the objects collectively which are included under it; thus European is more extensive than French, Frenchman, German, etc. Matter and mind are the most extensive terms of which any definite conception can be formed. Extension is contrasted with comprehension or intension. See PHYSICS.

Extension, University. See EDUCATION; UNIVERSITY EXTENSION.

Extension Teaching. See HOME EDUCATION; UNIVERSITY EXTENSION.

Extenuating Circumstances, in legal practice, those circumstances, in connection either with the position of the prisoner or with the act alone, which are taken into consideration by the court in mitigation of the punishment. The previous good character of the person convicted may always be proved as a circumstance giving him some claim to leniency of punishment. Besides character, there are other circumstances, the presence of which in a case sometimes serves to mitigate the sentence, sometimes to take the act done out of the category of crime altogether. One is youth. Thus, no act done by any person under seven years of age is a crime. Defective mental power in the person convicted will always be considered in determining the severity of his sentence. Such disease of mind as prevents a man from knowing that the act he does is wrong will excuse him from the consequences of an act otherwise criminal. Drunkenness, when voluntary, is not held an extenuating circumstance, but if a man is made drunk by the fraudulent administration of drugs, and while under their influence kills another, not knowing what he does, the act is not a crime. It is a good excuse for persons charged with crime that they have been compelled by others by threats of death or great violence to do the criminal act; and the acts of a married woman in presence of her husband are presumed to be done under his coercion, and so, unless the presumption is rebutted, will be excused. Ignorance of the law is no excuse for an offense. Nor, in general, will ignorance of facts be a good excuse, though in particular circumstances it might form a valid defense. Sir James Fitzjames Stephen states, in language purposely vague, to represent the vagueness of the law, a principle under which the stress of necessity is held to excuse acts otherwise criminal. He says: "An act which would otherwise be a crime may in some cases be excused if the person accused can show that it was done only in order to avoid consequences which could not otherwise be avoided, and which, if they had followed, would have inflicted on him or on others whom he was bound to protect inevitable and irreparable evil, that no more was done than was reasonably necessary for that purpose, and that the evil inflicted by it was not disproportionate to the evil avoided."

Extinct Animals. Many animals which inhabited the earth in bygone periods have entirely disappeared, leaving not even a modern representative of their race. Others, no doubt, were known to pre-historic peoples, concerning which no record has come down to us. But, within the period of recorded observations, many animals have lived and died out; various causes contributing to their extermination, not least among these being the presence of mankind. Man reconstructs the face of the earth to suit his needs: he cuts down forests, plows or burns over prairie lands, changes the course of rivers, drains the swamps, and thus destroys the natural environment of many of nature's wild children. Then, too, he destroys creatures directly; he kills them for food, for clothing, or for other utilitarian purposes; he hunts them because he fears them, as dangerous foes to himself, or to his agricultural pursuits; he destroys them for his sport; and, finally, he draws them from feral conditions by domestication. Not only thus does man directly injure the wild creatures; but his coming, accompanied by exterminating influences, kills out certain other creatures. These, when man has destroyed their natural prey, practically die of starvation before they can adapt themselves to changed conditions. Then the domestic dogs, cats, etc., help on the work of slaughter in certain ways, by preying upon wild life.

That pre-historic man was partially responsible for the extinction of certain animals, scientists are agreed; but they are also assured that except in the cases of the horse, the camel, and perhaps the domestic dog, the extinction was due more to their inability to adapt themselves readily to the changes of climate of that remote time, than to human agency. The wild progenitors of the horse and camel have not been known in historic times. That aboriginal man in Europe aided the elemental forces in their work of destruction, by hunting to death the mastodon, and the great cave-haunting lions, bears and hyenas, and other huge creatures of his time, is most probable; but in America this is not at all likely to have been the case.

Since the earliest records were made, however, various species have been eliminated from the European fauna; many from that of the other continents as well. In the days when the Romans fought the Dacians, various members of the cat family were common along the Rhine-Danube frontier, among them, lions, tigers, leopards, and wild-cats. They found also the great herds of wild cattle, which have entirely vanished. The ibex, too, is gone, and, but for the protective legislation, the chamois and the deer would have been exterminated, as well. The bear, the beaver, the wolf, and the wild boar, have all gone, within the last 10 centuries, from Britain, the wild-boar, which was hunted by royal cavalcades, disappearing at the close of the 17th century.

Records concerning Asiatic animals show few cases of extinction except those of a few cases of a species of sea-cow native to the Commander Islands, off the Kamchatkan coast. This animal, the rhytina, was pursued for its flesh, chiefly, and, so far as is known, the last survivor was killed in 1768. Among the same islands lived the now extinct Pallas's cormorant, a great bird also exterminated because of its edible quality.

Animals which are restricted in habitat to small islands seem liable to suffer from the inroads of man, more surely and swiftly, because they have no adequate means of escape, many such examples being furnished of birds whose power of flight is limited. Such species, especially in the Australasian and South Sea islands, have been in almost all cases, destroyed; notably several representatives of the moa tribe in New Zealand, the dodo, the solitaire, and certain parrots, rails, and fowls. The disappearance of the gigantic edible tortoises from the islands of the Indian Ocean and from the Galapagos, presents another striking instance of the extermination of animals owing to man's depredations.

Both Africa and America have presented fields for indiscriminate slaughter. In the former continent, where once there roamed great herds of antelopes, countless buffaloes and elephants, the slaughter has been so great since the middle of the 19th century as to make many of these denizens of plain and forest extremely rare, if not altogether extinct. The search for hides was perhaps the strongest destructive force; but the European hunters for «big game,» and their followers, have done much in the same direction. The mountain zebra, the quagga, and various species of antelopes are examples of this; while the giraffe, to escape entire extinction, has retired to almost inaccessible regions in the Kalahari Desert and northward.

As for America, with her long list of lost species, most people are more or less acquainted with the efforts that have been made (and sometimes with signal success), within the past few years, to save, by protective legislation, such of her native birds as are still found; and to prevent the wholesale slaughter of her wild denizens of field and forest. The best-known example of extinction is furnished by the bison (q.v.), which roamed in vast herds over the grass lands, until it was destroyed by hide-gatherers; so that now there are no wild bison except one small herd, carefully protected by law, dwelling beyond the North Saskatchewan River. The American sea-elephant and the monk-seal are also practically gone; and the long lists of birds, from the great auk and the «passenger pigeon» to the California condor, give evidence how much this continent has been depleted as to its wild life. Many fishes, too, have decreased or wholly disappeared; and there is no doubt that, but for timely protection, many species, now small, would soon follow these vanished representatives of the earlier fauna, and swell the already lamentably long list of extinct animals. See Species, Extinction of.

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Extinction of Species. See Species.

Extra-uterine Gestation. See Pregnancy.

Extract, a term to denote all that can be dissolved out of a substance by a specified menstruum, such as water, alcohol, ether, etc. In modern pharmacy the term is applied to two kinds of preparation from vegetables. One is obtained by digesting the plant in water or other solvent, and evaporating or distilling away the excess of solvent till the extracted matter is sufficiently inspissated. The other is obtained by bruising the plant in a mortar, separating the juice, warming it till the green coloring matter separates, and filtering it off. The juice is next heated till the albumen coagulates, and again filtered. The juice is now evaporated to a syrup, the green coloring matter added and well mixed, and the evaporation is thereafter continued till the required concentration is attained. Extracts must be capable of being redissolved, so as to form a solution like that from which they were derived. Extracts are used in cookery, medicine, and the manufacture of perfumery.

Extract of Meat is a soft, yellowish-brown, solid or very thick syrup, which is employed as a portable soup. It is now manufactured on the large scale by processes proposed by Liebig. Finely chopped flesh is exhausted with water, the extract is heated, when, at 133° F., albumen coagulates; afterward the blood coloring matter also separates, and when these are removed and the clear liquid is evaporated at a low temperature, the extract is ready. This substance has a characteristic odor of roast meat, has a strong taste, dissolves in water, and forms a not unpalatable soup. It contains no fibrin, gelatine, albumen, or fat, but creatine, inosic acid, and other organic bodies are present, and it is especially rich in potassic salts and in phosphoric acid. It has the invaluable property of not spoiling by keeping; and it has been strongly recommended for its nutritious qualities; but its price limits the sale, and there is, besides, a dislike to food from other sources than perfectly fresh and new meat. It is very useful, however, for travelers, for troops, and for all persons who have to carry supplies of food about with them, or to prepare it rapidly.

Extradition is the surrender of a criminal who has escaped from a territory under one government and taken refuge in a territory under another government. Extradition has two specific meanings in the United States. In the first place it refers to the surrender by one State government of a criminal who seeks asylum from another State of the Union in which he is held to be guilty of a heinous crime. (See Extradition, Interstate.) In the second place, it refers to the surrender of a criminal by one nation to another. The demand for extradition made by one nation of another is a matter of international law, and implies merely the control to be exercised by one nation over the right of affording asylum claimed by another. The Jay Treaty of 19 Nov. 1794 with Great Britain specified for powers of extradition during a period of 12 years. After its expiration in 1807 no provisions for international extradition were renewed until 1842 when the Ashburton treaty of 9 August of that year with Great Britain was concluded, in which extraditable offenses were enumerated. France on 9 November was the next country to enter into a treaty of extradition with the United States, since when treaties have been arranged with some 24 foreign governments providing for the mutual extradition of criminals, fugitives from justice, charged with heinous crimes, among which are enumerated robbery, burglary, arson, rape, embezzlement and the making and circulation of counterfeit money. In order to justify a claim for extradition, it is necessary to establish that the supreme political authority in the country where the crime has been committed has made a demand for the criminal's surrender; that an inquiry has been made into the facts of the case by a judge or United States commissioner, under direction of the President, in cases where the demand comes to the United States government from abroad; that a complaint be made on oath before the judge or commissioner; that a warrant be issued by the judge or commissioner for the apprehension of the party charged; that the charge be supported by suitable evidence; that a certificate be sent to the President of the United States signed by the commissioner, and stating that the charges are sufficiently well-grounded to warrant a surrender; that such certificate so satisfy the President that he grant the writ of surrender.

The British extradition act of 1870 makes special provision that no criminal shall be surrendered for a political offense, and that the criminal shall not be tried for any but the crime of which he was demanded. In 1890 an extradition treaty was ratified between Great Britain and the United States extending somewhat the list of extraditable offenses in the direction of the commercial crimes of fraud and embezzlement. Consult: Moore's 'Treatise on Extradition and Interstate Rendition' (1891).

Extradition, Interstate. The New England Confederation of 1643 provided for mutual extradition of criminals between the different provinces; the Articles of Confederation did likewise; and the Constitution provides for it between the States, which are independent countries in all save the functions they have resigned to the general government. But the wording of the provision, though as definite as it can safely be made, leaves room for the widest difference in construction, and the evasion of the mandate in a large share of the cases that arise. It is: «A person charged in any State with treason, felony, *or other crime,* who shall flee from justice, and be found in another State, shall, on demand of the executive authority of the State from which he fled, be delivered up, to be removed to the State having jurisdiction of the crime.» But must the offense be a crime by the law of the State requisitioned as well as of the State demanding? The judicial decisions say decidedly no — that «the obligation to surrender the fugitive . . . is the same as if the alleged act was a crime by the laws of both.» On the other hand, the State executives, for obvious reasons, have stubbornly refused to tie their hands from exercising discretion, and have again and again acted on the theory that the offense must be a crime by the law of their own State. Thus, in the Dorr Rebellion (q.v.), Gov. Cleveland of Connecticut refused to extradite Dorr — though Dorr was actually using Connecticut soil to organize an attack on Rhode Island — on the ground that the latter's treason laws were not valid outside itself; and Gov. Seward of New York refused to surrender persons charged with stealing slaves (though his predecessors had done so), on the ground that it was not a crime by New York law, by common law, or the common consent of civilized nations. Even the principles of decision are not agreed upon. In some States the courts hold that the courts of the State making the demand are entitled to decide as to the sufficiency of the cause; in others their own courts make their own law without regard to that of the other States. Still another question is, whether the governor has any discretion in the matter, supposing his State law to demand extradition. The answer is somewhat startling; it is, that the governor legally has no discretion, that he is imperatively bound to issue the warrant, but if he does refuse, there is no power to compel him and no punishment for the refusal. The Constitution, in other words, has issued an imperative mandate with no provision for its enforcement. Indeed, it is difficult to see how there could be any; the only remedy being a State impeachment of its executive for malfeasance, which is out of the question in such cases. The forms of interstate extradition are provided in the act of 1793. The accused must be indicted in the State where the offense is committed; if the magistrate before whom the charge is brought is satisfied of its truth, he issues a warrant for the arrest of the criminal, and a copy is forwarded to the executive of the State, who makes requisition for the fugitive's surrender on the executive of the State to which he has fled. If the latter is satisfied of the legality of the process and the sufficiency of the evidence of guilt, he is to issue a warrant for surrender; but habeas corpus proceedings may always be interposed. The expense of the proceedings and transportation is borne by the State making the demand.

Extraordinary Ray. See LIGHT.

Extravagan'tes, two collections of decretals and constitutions of popes which were made up subsequent to 1317. Before the *Extravagantes* the Canon Law comprised the *Decretum* of Gratian (1234), the *Liber Sextus* (1298), and the *Clementinæ* (1317). No further collections were made by papal command, nor were any further collections officially promulgated; nevertheless, two collections were made by jurists, the *Extravagantes* of John XXII., and the *Extravagantes Communes;* and these, though lacking official promulgation, came in time to be recognized as part of the Canon Law. The *Extravagantes* of John XXII. consist of constitutions of that Pope only; the *E. Communes* comprise decretals of several popes between 1298 and 1484. The *Extravagantes* are so called because they wander out beyond (*extravagantur*) the limits of previous collections.

Extravaganza, ĕks-trăv-ạ-găn'zạ, in music and the drama, a species of composition designed to produce effect by its wild irregularity and incoherence; differing from a burlesque in being an original composition and not a mere travesty. See DRAMA; STAGE.

Extravasa'tion, in contusions and other accidents, occurs when blood vessels are ruptured by the injury, and the blood finds its way into the neighboring tissues. A good illustration may be found in an ordinary bruise, when the part becomes blue in consequence of the vessels having been ruptured, and blood having escaped into the tissues. Extravasation in the cranium is a most serious accident, as the pressure on the brain which is the result often produces death very rapidly. The term is, however, applied to the escape of any fluid into the tissues from the vessels or cavity containing it.

Extreme Unction, a sacrament of the Roman Catholic Church for the bodily and spiritual comfort of the sick whose death is deemed to be imminent. The words of the apostle St. James in his epistle, ch. v., «Is any among you sick," etc., relate to this sacrament. The unction therefore is administered to the sick, and to those only who are in danger of death from sickness or from injury or accident; hence, it is not administered to persons under sentence of death, nor to those about to undergo a dangerous surgical operation, or the like; neither is it administered to children who have not reached the age of reason; for the principal end of this sacrament is, not restoration of bodily health, but forgiveness of sins. "If he has committed sins they shall be forgiven him." In the passage from St. James are found all the essential conditions of a sacrament, namely, the "outward sign," to wit: the anointing and the prayer of faith; and the "inward grace," typified by the outward sign, namely, forgiveness of sins. The divine institution of this sacrament is implied in the words of the gospel of St. James where it recommends its use and declares its efficacy for the remission of sins. Nevertheless extreme unction is not administered save after the person has made confession of his sins and received absolution in the sacrament of penance. In administering extreme unction the priest, with olive oil that has been blessed by the bishop, anoints the organs of the sense, pronouncing at each anointing the words, "By this holy unction and by his most tender mercy may the Lord forgive thee whatsoever sin thou hast commited by sight" (*per visum*), or "by hearing" (*per auditum*), etc.

Exuma, ĕks-oo'mă, **Great** and **Little,** two of the Bahama Islands. The Great Exuma is 30 miles long and 3 miles wide, and has a good harbor. Little Exuma has also a good harbor. The two islands together with Exuma Keys have an area of about 110 square miles. Pop. 2,374.

Eyas, ī'ąs, in falconry (q.v.), a hawk reared from the nest.

Eyck, īk, **Hubert van,** Flemish painter: b. Maaseyck, near Liège, Belgium, 1366; d. Ghent 18 Sept. 1426. It has been claimed that he and his brother Jan were the inventors of oil painting. For transparent and brilliant coloring and minute finish their works have never been surpassed. Their masterpieces are for the most part in Ghent, Bruges, Antwerp, Berlin, Munich, and Paris. The only painting that can now certainly be assigned to Hubert is the altarpiece with folding doors, 'The Adoration of the Lamb,' begun by him and finished by Jan, and afterward presented to the Cathedral of St. Bavon, Ghent, where only the two central divisions now remain, the wings being in the Gallery at Berlin, with the exception of those representing Adam and Eve, which are in the Brussels Museum.

Eyck, Jan van (also called **Jan van Brugge,** or **John of Bruges**), Flemish painter: b. Maaseyck about 1381; d. Bruges 9 July 1440. Hubert (q.v.) gave him his first instruction in the principles of the art, and his talents were so rapidly and vigorously developed that he soon surpassed his brother. The two resided at Bruges, then much frequented by the noble and the wealthy on account of its flourishing commerce. About 1420, or soon after, they went to Ghent for a considerable time, to execute together a work which Jodocus Vydt, a Flemish noble, had engaged them to do. This is the celebrated 'Adoration of the Lamb' for the cathedral of Ghent; a painting which contains above 300 figures, and is a masterpiece. It is painted on wood, with side panels which contain the portraits of the two artists and of their sister Margaret (q.v.), likewise a painter.

The reputation of this celebrated painter became very notable, even during his lifetime, by his great share in the introduction of oil painting; the original invention of which has been incorrectly ascribed to him by many. It was a general custom, before his time, to have for the background of the picture a flat gold ground, from which the figure stood out without perspective, as may still be seen in numberless works of earlier date. Van Eyck followed this practice in his earlier efforts, but, as he made further advances in his art, conceived the idea toward which there had been hitherto only some distant advances of giving a more natural grouping and perspective to his figures by a natural background. In this he succeeded so eminently, as many of his still remaining works prove, that he may be called in this respect the father of modern painting, since he gave the art a new turn and impulse, and laid the foundation of that high degree of improvement which it afterward attained in the brightest era of the great masters who succeeded him in the Netherlands and in Italy. In the art of painting on glass he is considered as the author of the mode of painting with colors delicately blended and yet so firmly fixed that obliteration was impossible — an object before attained only by joining together (in mosaic) several small panes of different colors. The school of which he was, in some measure, the founder, does not yield in celebrity to the best contemporary or succeeding artists, although it must be allowed to be often defective in the representation of the extremities of the human body — a fault occasioned by that excessive delicacy which prevented the study of naked forms, and of anatomy in general. On the other hand, the face, dresses, grouping, distribution of light and shade, are always superior, and the color brilliant and splendid, in the works of this painter and most of his scholars. Many of his paintings are still preserved, either in churches and museums, or in private collections.

Eyck, Margaret van, Flemish painter, sister of Hubert and Jan van Eyck: d. about 1430. A 'Virgin and Child,' in the National Gallery, London, was formerly assigned to her, but in the catalogue of 1889 is attributed to an unknown painter of the Early Flemish school; and she is believed to have executed the miniatures in the missal of the Duke of Bedford.

Eye, August von, ow'goost fŏn ī'ĕ, German historian and critic: b. Fürstenau, Hannöverschen, 24 May 1825. His 'The Kingdom of the Beautiful' (1878); 'The Life and Work of Albert Dürer' (1860), together with his studies in art developments and tendencies, have been widely read.

Eye, the peripheral organ of vision by which light and images from the outer world are received and from which these images are transmitted to the visual centres in the brain or its equivalent by means of nerve fibres.

Anatomy and Physiology of the Human Eye. — The human eye is situated within a quadrilateral pyramidal cavity, surrounded by bony walls, called the *orbit.* The bony walls separate the orbit from the neighboring cavities, namely, the intracranial, the frontal, the nasal, and the Highmorean antrum. The anterior opening of the orbit forms the base of the pyramidal cavity; the apex lies in the depth and is penetrated by a number of openings for the passage of blood vessels and nerves. The bony rim of the anterior opening of the orbit is called the orbital margin. It is made up of very hard bone-tissue. Its upper, outer, and lower parts are more or less sharp and overhang the interior of the orbit slightly. The nasal part is rounded off toward the nose.

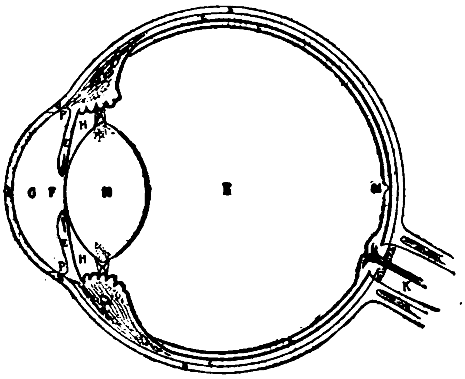

FIG. 1.

The walls of the orbit are formed by the union of seven bones of the skull and face. The upper wall consists of the frontal and sphenoid bones; behind its margin temporally it has a depression for the orbital lacrimal gland, near its nasal end there is a depression for the supraorbital artery and nerve and for the pulley through which the superior oblique muscle goes to the eyeball. The outer wall consists of the zygomatic and sphenoid bones. The lower wall, which is higher on its nasal than on its temporal side, consists of the supramaxillary, zygomatic, and palatine bones. The inner wall consists of the ethnoid, lacrimal, and sphenoid bones. All of the walls have openings and grooves for the passage of blood vessels and nerves. Where the supramaxillary and the lacrimal bones join together they form a bony canal for the lacrimal nasal duct.

At the apex of the orbit lies a round or oval funnel-shaped opening, the optic canal or foramen, through which the optic nerve comes from the brain; it runs slightly inward and upward. With this nerve, and underneath it, the ophthalmic artery enters the orbit. At the junctions of the outer wall with the upper and lower ones two fissures are formed, the upper one the sphenoid and the lower one the sphenomaxillary fissure. The ophthalmic nerve and vein, and the motor-nerves for the eye pass through the former.

The nasal walls of the two orbits run nearly parallel with each other, while the temporal walls converge toward each other. Therefore, the axes of the two orbits diverge towards their bases. The conformation and situation of the orbits and of their walls differ within certain limits very much in different individuals. They are sometimes so misshaped as to displace their contents and to interfere materially with comfortable binocular vision.

The periosteum of the orbital walls, which comes from the dura mater of the brain, besides covering the bones, furnishes numerous trabeculæ which hold the contents of the orbit in place, a sheath for the optic nerve, a serous capsule in which the posterior four fifths of the eyeball are encased and rotate (Tenon's capsule), and an anterior fascia-like diaphragm pierced by the anterior fifth of the eyeball. The posterior part of the orbit, besides blood vessels, nerves, and muscles, contains the orbital fat, which forms an elastic cushion on which the eyeball rests. Fig. 2.

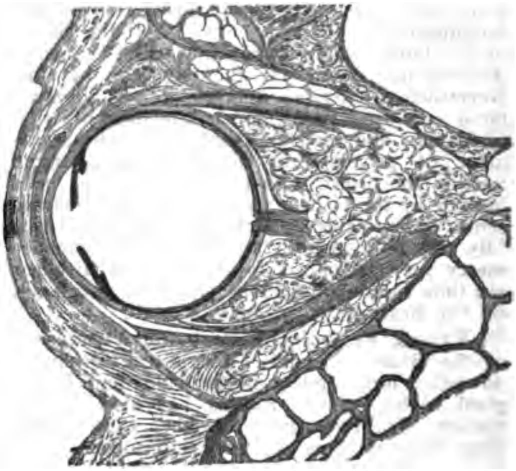

FIG. 2.

The eyeball itself consists of three membranes and several additional organs. The outer membrane, by which the shape of the eyeball is retained, has two parts of the cornea (horny membrane) (A, Fig. 1) and the sclerotic (hard membrane) (B, Fig. 1). The shape of the eyeball is nearly that of a sphere with the segment of a smaller sphere superadded anteriorly. The former (sclerotic) makes up about four fifths, the latter (cornea) one fifth of the eyeball. The former appears white, is very tough but elastic and translucent. The latter is, also, very tough and elastic, but perfectly transparent with a refractive index like that of water. The sclerotic consists of very dense connective tissue, similar to tendon-tissue, the fibres of which are interwoven in an irregular manner and form bundles. In a general way these bundles run in a meridional direction, but equatorial ones are always to be found anteriorly at the junction between cornea and sclerotic, and posteriorly where the optic nerve enters the eyeball. These fibres and bundles are held together by a cementing substance in which lie lymphatic canals and stationary cells. The sclerotic has but few and small blood vessels and nerves of its own, but gives passage to all the blood vessels and nerves which enter the interior of the eyeball or come from it. The former are the ciliary nerves, the optic nerve, and the ciliary arteries, the latter are the vorticous veins of which from four to six carry the blood away from the interior of the eyeball at or near its equator. Where the optic nerve enters the eyeball there is not one large opening for its admittance in the sclerotic, but the optic nerve fibre bundles pierce the sclerotic tissue separately. Thus this part of the sclerotic has a sieve-like appearance (*lamina cribrosa*). The tendons of the muscles of the eyeball are inserted into the sclerotic after having pierced Tenon's capsule.

The cornea is joined to the sclerotic anteriorly very much like a watch-crystal to its rim, that is the translucent tissue of the sclerotic slightly overlaps the transparent corneal tissue on the outer surface. The tissue of the cornea proper is a modified, perfectly transparent, dense connective tissue which consists of finest fibres united together by a cementing substance into bundles and these again into layers (*lamellæ*) which run more or less parallel with its surface. The layers are thicker in the posterior part and grow thinner toward the surface and finally form one perfectly compact layer, Bowman's or Reichert's membrane, on the outer surface. This may be looked upon as the basal membrane on which rests the outermost coating of several layers of epithelial cells. The inmost layer of these is single and is formed of cylindrical cells, then follow flatter and flatter cells outwardly, the outermost layer being true pavement epithelium, the cells of which never undergo a horny metamorphosis like those of the epidermis. The posterior surface of the corneal tissue proper is lined with a thin elastic vitreous membrane, Descemet's membrane, on which rests posteriorly a single layer of endothelial cells. In the cementing substance of the cornea lie very numerous lymph canals, von Recklinghausen's canals, which contain the fixed corneal cells (corneal corpuscles) in lacunæ-like enlargements. The cornea proper has no blood vessels; a ring of vascular loops enters its periphery only to the distance of one millimetre. Where cornea and sclerotic are joined the fibres and lymph canals of the one membrane pass over into those of the other. Here, also, a larger ring — like venous plexus, Leber's venous plexus or Schlemen's canal, is embedded, by which fluids from the anterior chamber are carried off. A large number of ciliary nerves enter the cornea at its periphery, are at first distributed in the corneal tissue proper, then having been divided into branches and just under Bowman's membrane into terminal fibres, they pierce this membrane and are lost in the epithelial cells.

Inside the sclerotic and loosely connected with it except at two points (the nerve entrance and the tendon of the ciliary muscle) lies the uveal tract, the vascular membrane of the eye. This membrane is divided into three distinct parts with distinct functions. The posterior one is the *chorioid* (C, Fig. 1); forward from it lies the *ciliary body* (D, Fig. 1); and in front of this the *iris* (E, Fig. 1). The chorioid begins around the entrance of the optic nerve and reaches forward beyond the equator of the eye. Inwardly it is lined by a very thin elastic membrane, the *lamina vitrea;* outwardly fibres of its tissue mingle with those of the sclerotic, leaving lymph spaces between them, *lamina suprachorioidea* and *fusca.* The tissue proper of the chorioid is made up of very loose connective tissue in which are embedded innumerable stellate pigmented cells and endothelial cells. The pigment in the stellate cells varies from almost no tint in the albino to jet black in the negro. In the loose connective tissue lie, furthermore, the innumerable blood vessels of the chorioid. The arteries coming from the short posteriociliary arteries and the veins, forming together the vorticous veins, lie in the outer two, the capillary blood vessels in the inner third of the membrane (Fig. 3). In the suprachorioideal tissue the long posterior ciliary arteries and the ciliary nerves run forward to the ciliary body. The function of the chorioid is the nutrition of the interior of the eyeball, especially of the outer layers of the retina, and the absorption of light.

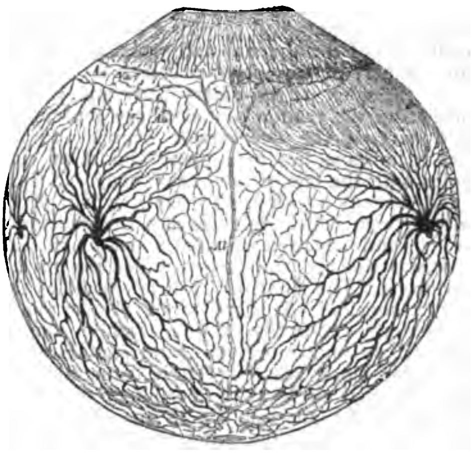

FIG. 3.

On the inside of the *lamina vitrea* lies a single layer of mostly hexagonal epithelial cells filled with pigment, the *pigment epithelium,* which though genetically belonging to the retina, must be looked upon as a gland-like organ interposed between retina and chorioid. Its cells send pigmented offshoots in between the outer parts of the rods and cones of the retina and by their secretion give the rods a slightly purplish tint, the retinal purple. This purple is continually bleached by the action of light and regenerated in the dark. Thus photochemic changes are produced, the exact value of which for the function of vision is as yet unknown.

Somewhat in front of the equator the chorioid becomes thicker, at first slowly and then more abruptly, and wrinkled, and thus the second part of the uveal tract in the ciliary body is formed (*pars non-plicata* and *plicata*). The thickening of the tissues is due to the addition of muscular tissue on the outside of the chorioideal tissue proper. This is the ciliary muscle or muscle of accommodation. Its anterior tendon is inserted into the corneo-scleral tissue inward of Leber's plexus, its posterior tendinous fibres are lost in the fibrous tissue of the chorioid. We recognize in this muscle two sets of fibres, one running meridionally on the outside, the other lying inward and forward running in an equatorial direction. The two act, however, together. In nearsighted eyes the former is more developed, in farsighted eyes the latter. The inner surface of the ciliary body which is represented by the chorioideal tissue shows about 70 meridional folds, the ciliary processes, on which microscopically a great many smaller wrinkles can be recognized and by which means the surface is immensely increased. These are covered by the continuation of the pigment epithelium and a layer of cylindrical unpigmented cells, the continuation of the retina, the retinal part of the ciliary body. The function of the ciliary body is twofold. Its muscular tissue governs the accommodation of the eye; the wrinkled inner surface is an immense secreting surface for the production of the aqueous and probably also, the anterior part of the vitreous body.

At the apex of the ciliary body and just inward from the tendon of the ciliary muscle, the third part of the uveal tract begins, the *iris*. This membrane lies in a plane almost at right angles with the one of the ciliary body. It has a round central opening, the pupil, which is the hole through which light reaches the interior of the eye and which is smaller when much light falls into the eye and larger under the reverse conditions. The tissue of the iris resembles that of the chorioid. It consists of a very loose, sponge-like connective tissue, richly supplied with stellate pigmented cells, and containing innumerable blood vessels. These come from the larger arterial circle at the periphery of the iris formed by the anastomosis of the branches of the long posterior and anterior ciliary arteries. They form a capillary network near the pupillary edge of the iris, the small iris circle. Both the anterior and the posterior surfaces of the iris show later in life circular folds and wrinkles, especially near the periphery, which result from the play of the pupil. Moreover, the anterior surface is studded with smaller and larger openings leading into small pouches, crypts of the iris. Posteriorly the iris is covered by the continuations of the two cell layers which cover the inner surface of the ciliary body. On the iris both of them are deeply pigmented so that without bleaching it is impossible to recognize the single cells. This pigmented layer reaches inward to the pupillary edge. The anterior surface of the iris is covered by endothelial cells. At its periphery the iris tissue receives fibres which come from Descemet's membrane and the innermost layers of the cornea, and which together form a network lying inside of the tendon of the ciliary body. This network of fibres which are partly covered by endothelial cells is called the pectinate ligament; the openings in it are called Fontana's spaces. Through this tissue the fluids passing out of the eye are filtered. The angle formed by the iris and corneo-scleral tissue is, therefore, usually termed the filtration angle of the eye. Around the pupillary opening and lying near the posterior surface of the iris a ring muscle is situated by the contraction of which the pupil is made smaller. A layer of spindle cells in front of the pigmented layer seems to represent an antagonistic pupil-dilating muscle. The function of the iris is that of a movable screen with a central opening, the size of which by reflex action regulates the amount of light which is to fall into the eye, the pupil contracting in strong and dilating in weak light. The pupil also contracts during the acts of accommodation and convergence.

Inward from the chorioid and closely applied to it lies the nervous membrane which receives the images, the expansion of the optic nerve, the *retina* (L, Fig. 1). This membrane consists of the optic nerve fibres to which are added nerve cells and neuro-epithelial cells, the whole held together by connective tissue, Mueller's fibres. The optic nerve (K, Fig. 1) having entered the orbit through the *foramen opticum,* and on its way to the eyeball, has three sheaths, the *dura mater* and *arachnoid* together forming the outer and the *pia mater* an inner sheath which closely invests the whole nerve and sends numerous trabeculæ into it which hold its fibre bundles together and in place. Between the sheaths lies the intervaginal space, a lymph-space communicating with the intracranial cavity and with the lymph-spaces in the eyeball. The dura mater and arachnoid together join the sclerotic where the nerve enters through this membrane, the pia mater ends where the nerve passes through the chorioid, unless we can look upon Mueller's fibres as its continuation. The double contoured nerve fibres coming from the chiasma lose their Schwann's sheath just before the nerve reaches the eyeball. Having reached the inner surface of the chorioid the fibres turn abruptly so as to cover the interior. This manner of distribution causes the nerve fibres at first to form a roundish elevation with a central depression, the optic papilla. This part consisting of conducting fibres only, does not perceive images and is known as Mariotte's blind spot.

The optic nerve fibres form the inner layer of the retina. The retina proper getting thinner and thinner reaches forward to the ciliary body where it ends with a serrated edge, *ora serrata.* It has a very complicated structure and including the pigment epithelium, has 10 distinct layers. The other nine are the rods and cones, the outer limiting membrane, the outer granular layer, the outer molecular layer, the inner granular layer, the inner molecular layer, the ganglion cell layer, the nerve fibre layer and the inner limiting membrane. The impressions received in the rod and cone layer are carried from neuron to neuron and finally back to the brain centres. The point of most acute perception lies opposite the center of the cornea, about 15° outward from and a little above the optic papilla. It is called the yellow spot (*macula lutea*) and has a central depression, the *fovea centralis.* Here the retina gets thinner on both surfaces till it consists but of a few nerve cells and conducting fibres, the rods have disappeared and the outer layer is formed of cones alone. The cones must, therefore, be considered as the organs of greatest importance in the act of distinct vision. From the neighborhood of the macula lutea to the ora serrata the proportion between rods and cones increases continually in favor of the rods. The retina is supplied with blood vessels in its inner layers only. They come from the central retinal artery and supply the retina only.

Close behind the iris lies the crystalline lens (N, Fig. 1), a lentil-shaped transparent body enclosed in a transparent capsule, the anterior half of which is thicker than the posterior one. The anterior capsule is lined with a single layer of cuboid epithelial cells which a little behind the equator of the lens grow longer and longer and form the lens fibres, long prismatic bands, of which the bulk of the lens tissue consists. These bands are arranged concentrically, new ones being added from the surface to the older ones which form a dense nucleus in the centre of the lens. With advancing age this nucleus grows larger, harder and less and less elastic. The lens is held in position by a ring of glassy tough fibres, the zonule of Zinn (O, Fig. 1) or suspensory ligament, which being firmly attached to the ciliary body and its processes, insert themselves on the anterior and posterior capsules near the equator. The origin of these fibres is still doubtful. The function of the lens is to focus images on the retina.

Behind the lens and supporting it in a cup-shaped depression, *fossa patellaris,* lies the *vitreous body* (I, Fig. 1). It fills the large posterior cavity of the eyeball. It is a perfectly transparent gelatine-like substance in which fine fibrillæ and a few wandering cells are found.

The space bounded by the inner surface of the cornea, *ligamentum pectinatum,* anterior surface of iris and anterior lens capsule, as far as it lies in the pupil, is called the *anterior chamber* (G, Fig. 1). The prismatic ring bounded by the posterior surface of the iris, the anterior part of the ciliary body, the zonule of Zinn and the peripheral part of the anterior lens capsule, is called the *posterior chamber* (H, Fig. 1). These two chambers are filled with a watery fluid, the *aqueous humor.*

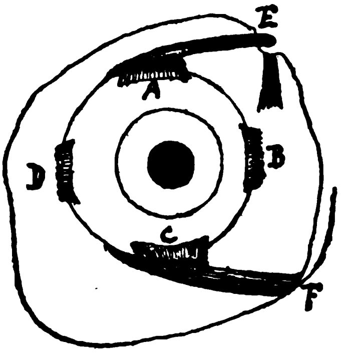

FIG. 4.

The eyeball within certain limits, can be moved in all directions around a centre of rotation by means of six *muscles* (Fig. 4). Five of these come from the apex of the orbit (Fig. 5). Four of these five, the recti muscles, run almost straight forward to their insertion on the sclerotic, namely, the superior, inferior, inner (nasal) and outer (temporal) rectus muscle. The fifth one, the trochlearis or superior oblique muscle, runs forward to the upper orbital margin, there passes over a pulley and returns to the eyeball from above in an oblique direction. The sixth muscle, the inferior oblique, springs from the lacrimal bone and running backward inserts itself on the eyeball in an oblique direction from below. The recti muscles turn the eye, the oblique ones roll it. By the single or combined action of these muscles the eye can be turned in all directions.

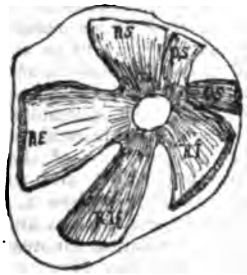

FIG. 5.

The *eyelids* are formed by two duplicatures of the skin, an upper and a lower one. The inner skin lying close to the eyeball assumes the character of a mucous membrane, the palpebral conjunctiva. It is folded over on the anterior third of the eyeball which it covers to the corneal periphery, bulbar or ocular conjunctiva. The fold of reversion, fornix or cul-de-sac, is very loose, so that the motions of the eyeball are not interfered with. When the lids are closed, the parts of the conjunctiva form with the cornea a closed sac, the conjunctival sac.

At the free margin of the lids, skin and conjunctiva merge into each other. This free margin has two edges, an inner sharp one and an outer rounded one; between them lies the intermarginal space, in which lie the eyelashes and the orifices of numerous glands. The stiffness of the lids is due to the very dense tarsal tissue plates which, semilunar in shape, form the inner layers of the lids, to which the palpebral conjunctiva is closely adherent. In this tissue and near its posterior surface lie the Meibomian glands which secrete a fatty substance the presence of which prevents the tears from running over the edges of the lids. In front of these the eyelashes, *cilia,* spring forth, short, strong, curved hair which interlock when the lids are closed. They live only about 100 days, and then fall out to be replaced by new ones. The lashes have the usual sebaceous glands and between them lie the so-called modified sweat glands of Moll. Between the outer skin and the tarsal tissue the fibres of the orbicularis muscle are embedded which when contracting closes the lids. The upper lid is rolled backward on the eyewall in the act of opening by means of its levator muscle which coming from the apex of the orbit is inserted on the upper edge and anterior surface of the tarsal tissue. From the orbital edge of each tarsal plate a non-striated muscular layer goes backward into the orbital tissue, Mueller's muscle. The opening between the lids is called the palpebral fissure. Where they join each other the lids form an outer, sharp angle, outer canthus, and an inner rounded angle, the inner canthus.

The eye, as far as it is exposed to the air, is kept moist and lubricated by the tear-fluid. The glands secreting it and the means of carrying the surplus away together are called the *lacrimal apparatus.* The tears are secreted by a number of acinous glands. The largest one lies in the orbit in the lacrimal fossa of the upper orbital wall. Right underneath it in the upper eyelid itself and down beneath the canthus in the lower lid smaller glands are situated, and still smaller ones are found all along the upper edge of the tarsal tissue of the upper lid, clear over to the inner canthus. All of these glands empty their secretion into the conjunctival sac by means of ducts. The fluid flows over the anterior surface of the eyeball and towards the inner canthus where the drainage apparatus is situated. Behind the inner canthus of the lids lies a round, dermoid body supplied with sebaceous glands and hair, the lacrimal caruncle, and in front of it a semilunar fold of conjunctiva, the remnant of the third lid in animals. When the stream of tears reaches the fatty caruncle it is held back and thus more easily sucked up. This is done by means of two capillary lacrimal canaliculi, which have their orifices (*lacrimal puncta*) in little papillæ at the edge of each lid near the caruncle. The sucking up of the tears is materially aided by a special muscle, Horner's muscle. The canaliculus in the upper lid runs in a slight curve downward toward the nose, the one in the lower lid upward. They meet behind the junction of the lids, the internal palpebral ligament, and empty their contents either singly or together into a larger receptacle, the lacrimal sac, from which in turn the tear-fluid is drained by the nasal lacrimal duct which opens on the lower floor of the nose.

The blood supply of the eye comes from a branch of the internal carotid artery, the ophthalmic artery, which gives off branches to the optic nerve sheaths, the orbital fat, the muscles of the eyeball, the lacrimal gland, besides the supraorbital, posterior, ethmoidal, and naso-frontal branches. From the muscular branches of the four recti muscles the anterior ciliary arteries pass through the sclerotic to the ciliary body and iris. Fom the ophthalmic artery directly or from one of its larger branches spring about 6 arteries which in turn split into about 20 branches and enter the sclerotic and the chorioid directly in a ring around the optic nerve entrance, called the short posterior ciliary arteries. Usually two of these branches run very obliquely forward through the sclerotic before reaching the uveal tract, the long posterior ciliary arteries.

The central retinal artery, which supplies the retina alone, comes from the ophthalmic artery, or one of its larger branches, enters the optic nerve near its entrance into the eyeball and then lies in its central canal together with the central retina vein.

The venous blood coming from the eye and orbit is collected into a superior and an inferior ophthalmic vein, both of which carry it to the cavernous sinus; a small portion is carried off by the temporal and facial veins.

The *nerves* of the eye, aside from the optic nerve, are motor, sensitive and sympathetic nerves and enter the orbit through the sphenoid fissure. The trochlearis nerve goes to the superior oblique muscle, the abduceus nerve to the external rectus muscle. The oculo-motor nerve, soon after its entry into the orbit, forms two branches. The upper one of these goes to the superior rectus muscle and to the levator of the upper lid. The lower one splits into three smaller branches for the internal and inferior rectus and for the inferior oblique muscle. This last branch forms the short root of the ciliary ganglion. The ophthalmic nerve (the sensitive nerve) a branch of the trigeminus gives off the supraorbital, naso-ciliary and lacrimal nerves. The naso-ciliary nerve forms the long root of the ciliary ganglion. Thus this ganglion from which originate the short ciliary nerves which go to the eyeball, contains motor, sensory and sympathetic fibres, the latter from the carotid plexus. The short ciliary nerves reach the sclerotic in a ring around the optic nerve entrance. The long ciliary nerves come from the naso-ciliary nerve (Fig. 6).

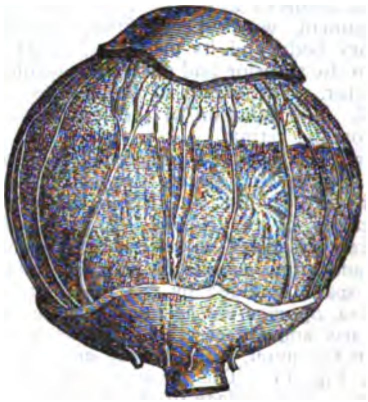

Fig. 6.

The optic nerve proper comes from the optic chiasma, the anterior commissure of the brain. The centres of vision are at present thought to lie in the occipital lobe of the brain in the cuneus and the region of the angular gyrus. From here fibres eradiate forward in the internal capsule to the pulvinar of the optic thalamus and are joined by fibres from the *corpora geniculata* and *quadrigemina*. These fibres together form the optic tract of each half of the brain. In the chiasma the two tracts join and partially cross each other, the smaller portion remaining uncrossed and going to the eye of the same side, the larger portion going to the eye of the opposite side.

Physiology.—As an optical instrument the eye has several refractive media. The main ones are the cornea and the crystalline lens. The curvature of the cornea, which is altered under special circumstances only, is not ideally spherical, but rather as if curved over a revolving ellipsoid. Therefore, most corneæ are asymmetrical in curvature, a condition which is called astigmatism. Rays of light impinging on the cornea are refracted so as to pass through the pupil; where they impinge on the crystalline lens by which they are farther refracted in such a manner as to come to a focus on the retina, on which an inverted image results. In order to change the focus of the lens so as to give clear images as well of distant objects, as of near ones, the eye is provided with the apparatus of accommodation. That is, it is enabled through the contraction of the ciliary muscle and the consequent increase in convexity of the lens to increase its refracting power and to shorten its focus or by relaxation to lengthen it. This faculty is gradually lost as age advances and at about 45 years of age accommodation for near objects can no longer be accomplished, *presbyopia*.

When an eye, perfectly at rest, focuses parallel rays on its retina it is called emmetropic. When in an eye, perfectly at rest, parallel rays are focused behind the retina, it is called hypermetropic or farsighted. When in an eye, perfectly at rest, parallel rays come to a focus in front of the retina, it is called a myopic or near-sighted eye. These differences depend chiefly on the axial length.

In astigmatism the asymmetry of the curvature of the cornea (or the lens) prevents rays of light from being focused in one point. As we can in this case usually recognize a principal meridian of lowest and one of highest curvature which generally lie at right angles to each other, we may find a number of combinations, as for instance the focus of the one principal meridian emmetropic and the other hypermetropic, or the one hypermetropic and the other myopic, etc. In consequence of astigmatism no clear images can be perceived by the retina of such an eye.

The whole area in which an eye, when steadily gazing at one point, can perceive objects, is called its field of vision. This has an irregular round outline and for white reaches upward and inward to between 60° and 70°, downward between 50° and 60°, and outward to 90° and more. The fields for colors are smaller in the following order: Blue, red, green. The binocular field is not as large as twice the monocular one, since the fields overlap at the nasal side to quite a considerable extent.

In binocular single vision the images must fall on the so-called identical spots in the two retinæ. When they do not, double vision, *diplopia,* results.

The perception of colors, a faculty which in man is congenitally wanting in about four pro mille (sometimes in one eye only), has been explained by a number of theories. That of Young-Helmholtz and the one of Hering assume special nerve cells for the perception of different colors. Oliver and others believe in the central location of color perception. Others believe in a combination of the two arrangements.

Comparative Anatomy.— The eye of man is a comparatively perfect visual organ and optic instrument. The farther we go down the scale of the animal kingdom the less perfect, the simpler does the eye become. In a general way we may distinguish between eyes which can differentiate between light and dark only, and eyes which perceive more or less perfect images of objects. The former are those of the lowest animals which have barely light perception and perhaps orientation. The latter are those of the higher classes, especially the vertebrata. The eyes of this group are so arranged that they can perceive a number of impressions at the same time and independently of each other, or in other words, images perceived by such eyes are composed of a large number of single impressions arranged like mosaic-work. The finer the parts of this mosaic, the more detail is perceived. This arrangement has reached its highest development in the eye of man.

In this second group we may recognize three forms of eyes. The *composite eye* (see article on COMPARATIVE ANATOMY), that of insects and crustaceans, is a hemispherical body composed of a varying number of single eyes of which from 20 to many thousands have been counted in different insects. Covered by a common transparent membrane, the cornea, these eyes form little prismatic boxes with from four to six angles, which lie close to each other arranged like radii. Their walls are usually pigmented, and thus virtually a vertical ray only can enter each of them. Sometimes the inner end of these boxes is convex, forming something like a lens, sometimes a lens-like transparent body lies in front, or the cornea is thickened so as to act like a lens. Others have a crystal cone going from each box to the nerve fibre connected with it. Such eyes cannot change their focal power. A higher form of eye is found in the nautilus. It forms a small camera obscura with a narrow pupil through which the light is admitted. This eye is supplied with a retina covering the wall opposite the pupil, with no arrangements of adjustment. The highest form of the eye, as found in the vertebrata, is a camera obscura, with a collective lens, capable of different degrees of focal adjustment. In the lower vertebrates this adjustment is made by bringing the retina nearer to the lens, in the higher ones the refraction of the lens is changed by an apparatus of accommodation. The former eyes are particularly adapted for seeing near objects.

There is a close relation between the eye and the mode of life and habitat of its possessor. Animals living in the water, or being most active at dusk, have a large flat cornea and a large pupil which admit much light. Some have, even, a reflecting apparatus behind the retina. The mode of locomotion has something to do with the position of the eye. Thus in the vertebrates, arthropods and cephalopods the eyes are situated at the head, while in the sea star, for instance, they lie at the tip of each of the five rays, in the worms on their gills, etc.

Man and the higher animals have two eyes. Most insects and some crustaceans have two composite eyes and a number of single supernumerary ones. Spiders have eight, some worms four or more supernumerary eyes. Some mollusks have up to several hundred eyes which lie along their mantle.

The eyes of the vertebrates, cephalopods and some snails have an external muscular apparatus. Those of the crabs lie at the end of a movable stem.

The shape of the eyeball is more or less spherical with a difference in the radius of curvature of the cornea and sclerotic. No eye seems to be perfectly spherical. That of aquatic birds is flatter than that of birds living in the air. The fishes have the flattest eyes.

The tissues of which the eye is composed show interesting differences in different species. The cornea is thickest in mammals; in the bat it is even much thicker than the sclerotic. In the terrestrial animals the radius of the corneal curvature is smaller than that of the sclerotic, in the animals living in the water the reverse obtains. In the mammalia the sclerotic consists of dense connective tissue, in the remaining vertebrata cartilage and even bone is added to this. In a large number of fishes we find on the outer surface of the chorioid a layer of iridescent crystals, the so-called argentea, which acts as a light reflector. In other fishes a cellular or fibrous membrane is found near the inner surface of the chorioid, called tapetum. The mammals, also, have a tapetum, hence their shining eyes.

The osseous fishes have a voluminous separate vascular tissue, improperly called chorioideal gland, interposed between the outer and inner layers of the chorioid. In birds a fan-shaped membrane, containing bloodvessels and being pigmented, springs from the optic papilla and its neighborhood and reaches into the vitreous body almost or altogether to the lens, the pecten or fan. It is less developed in nocturnal birds. A similar rudimentary appendage is found, also, in the eyes of some lizards.

The ciliary body and muscle, so well developed in man, is less and less developed the lower the animal. In the fishes its function seems to be reduced to the support of the lens and the nutrition of the anterior parts of the vitreous body. The lower the animal and the less accommodative function, the more spherical is the lens. The more developed the apparatus of accommodation, the more lentil-shaped is this organ.

The optic nerves in the lower animals seem to be as a rule totally crossed in the chiasma. The retina in a general way is very similarly constructed in all vertebrates. While man and the higher animals have one fovea centralis only, a great many birds have two foveæ centrales. One seems to serve for monocular and the other for binocular vision.

Diseases of the Eye.— The eye is subject to a great many diseases, which may originate in the eye itself or be symptoms and consequences of some systemic disease. The lids, conjunctiva and cornea being in an exposed position are very apt to become injured and diseased by direct infection from the outside. Infection from within and attacking the inner coats of the eye at first is, also, observed frequently. Certain toxins circulating in the blood produce characteristic diseases in the eye, like the neuro-retinitis of Bright's disease and the retinitis in diabetes. Certain diseases of the eye can be brought in connection with its refractive condition, thus glaucoma is more frequently seen in farsighted, detachment of the retina in nearsighted eyes. Many internal eye diseases may be traced to uncorrected errors of refraction. Thus, perhaps, this plays a decided role in the production of cataract. Errors of refraction and unequal visual acuity cause the parallelism of the eyes to be lost, farsightedness leading to convergent and nearsightedness to divergent squint. Some eye diseases are due to poisons ingested; the best known examples of this are, perhaps, the amblyopia from the abuse of nicotine and alcohol and the optic neuritis due to lead poisoning. Systemic diseases, like syphilis, rheumatism, gout, tuberculosis, are apt to cause diseases of the uveal tract, especially iritis and chorioiditis or of the retina and optic nerve. Brain diseases may lead to inflammation or atrophy of the optic nerve and to paresis or paralysis of the external and internal ocular muscles. Diseases of the vascular system are apt to produce hemorrhages in the eye or plugging of the central retinal artery and vein. Diseases of the nose are apt to produce stoppage of the drainage apparatus of the tears.

Injuries to the eyeballs are very frequent and may cause very serious results, especially iridochorioiditis with shrinkage of the eyeball, and such eyes are particularly prone to affect the fellow-eye by sympathetic inflammation, an almost incurable disease.

The most frequent eye diseases are those of the conjunctiva and lids, as stated above. The very situation of the conjunctiva and its being moist and warm renders it especially liable to infection from without and favorable to the propagation of germs. Thus blennorrhœa neonatorum, gonorrhœa, diphtheria, trachoma, let alone the milder forms of conjunctivitis, are due to such extraneous infection, as are also ulcers of the cornea.

Any dimness in the transparent media of the eye must of necessity interfere with vision, thus scars on the cornea, cataract, opacities in the vitreous body, etc., render the eye nearly or totally useless.

The eye is, furthermore, not infrequently the site of malignant tumors, as epithelioma, sarcoma and glioma of the retina.

Unlike other organs the eye is very often subject to important congenital malformations and anomalies.

Bibliography. — Graefe-Saemisch, Handbuch der gesammte Augenheilkunde'; Alt, 'Lectures on the Human Eye'; Alt, 'Original contributions concerning the glandular structures appertaining to the human eye and its appendages'; Norris and Oliver, 'System of diseases of the human eye.'

A. Alt, M. D.,

Eyebright, a common name for the plants of the genus *Euphrasia* (q.v.).

Ey'erman, John, American geologist: b. Easton, Pa., 15 Jan. 1867. He studied at Lafayette College, Harvard, and Princeton, 1889–95, and was instructor in blow-piping at Lafayette 1888–93, and lecturer on determinative mineralogy. He has been an associate editor of the 'American Geologist' since 1890, and is a member of many English and American scientific societies. He has published: 'Notes on Geology and Mineralogy' (1889); 'Mineralogy of Pennsylvania' (1891); 'Course in Determinative Mineralogy' (1892); 'Bibliography of North American Vertebrate Palæontology' (1889–93); 'The Genus Temnœyon' (1895); 'A Study of Genealogy' (1898); 'General Index to the Wills of Northampton County, 1752–1802' (1898); 'The Old Grave Yards of Northampton' (1899–1901).

Eylau, ī'low, or **Prussian Eylau,** Germany, town, on the Pasmar River and the lake of Arschen; 22 miles south of Königsberg. It was the scene of a battle fought 7–8 Feb. 1807, between the French under Napoleon (q.v.) on the one side and the allied Russians and Prussians on the other side. (See Ney.) The French force numbered about 70,000, of whom fully 18,000 were killed. The allied forces were about the same in number with a loss of more than 18,000. Pop. 3,546.

Eyma, Louis Xavier, loo-ē ksăv-ē-ā ī-mā, French writer: b. Saint Pierre, Martinique, West Indies, 16 Oct. 1816; d. Paris 29 March 1876. After a tour through the United States, he returned to France and published several works, of which the best known are: 'The Women of the New World' (1853); 'The Red Skins' (1854); 'The Black Skins' (1856); 'The American Republic' (1861); 'The Slave Hunt' (1866); and many novels.

Eyra, ī'rā, in Scandinavian mythology, the physician of gods. See Mythology.

Eyra, a species of cat (*Felis eyra*) native to the western hemisphere from Mexico to Paraguay. It is rufous or chestnut in color, entirely without the spots found on other cats, except the puma, of which it seems almost a miniature. It has white spots on the face, is about the size of the domestic cat, and has rounded ears. The pupil of the eye also is round. The body and head are slender, and the tail is unusually long and thick. The legs are shorter than those of the domestic cat. The eyra is easily tamed, but never seems, even in domestication, to relinquish its fondness for preying upon poultry. In the feral state it hunts small animals and birds for food.

Eyre, ār, **Edward John,** English explorer and colonial governor: b. Yorkshire 5 Aug. 1815; d. Tavistock, Devonshire, 21 Dec. 1901. He went to Australia in 1833; in 1839 discovered Lake Torrens, and in 1840 explored its eastern shores and the adjacent Flinders Range. He then commenced his perilous journey along the shores of the Great Australian Bight, and reached King George's Sound, in western Australia, a distance of 1,200 miles, with a single native boy, having left Adelaide more than a year before. In 1845 he published 'Discoveries in Central Australia.' After filling several governorships he was appointed governor of Jamaica in 1862. In 1865 he was confronted with a negro rebellion which he crushed with some severity, and was recalled. On his return to England John Stuart Mill and others took measures to have him tried for murder, but failed. In regard to this question Carlyle was one of his most strenuous defenders.

Eyre, Lake, a salt lake of South Australia, lying due north of Spencer Gulf, at an altitude of 79 feet, and with an area of 3,706 square miles. Except in the season of rains, this lake is generally a mere salt marsh, and has no apparent outlet. It was discovered in 1840 by Eyre.

Eyre-Todd, George, Scottish miscellaneous writer: b. Govan, Scotland, 2 June 1862. He was educated at Glasgow University. He has published: 'The Lady of Ranza' (1884); 'The Sage of Thebes' (1885); 'Ossian' in Canterbury Poets Series (1888); 'Sketch Book of the North' (1890); 'Byways of the Scottish Border' (1892); 'Scotland; Picturesque and Traditional' (1895); 'Vignettes of the North' (1895); 'Anne of Argyle' (1895); 'The Book of Glasgow Cathedral' (1898); 'Bohemian Papers' (1898); 'Byways of Scottish Story' (1900); 'Songs of Caledonia' (1900); 'The Glasgow Poets' (1902).

Eyria (ī'rĭ-ạ) **Peninsula,** on the south coast of South Australia, triangular in shape, its base being formed by the Gawler Range, while its sides are washed on the southeast by Spencer Gulf, and on the southwest by the Great Australian Bight. It constitutes a rich pastoral country.

Eyster, Nellie Blessing, American writer: b. Frederick, Md., 7 Dec. 1831. She was married to A. S. Eyster 1853. She has published: 'Sunny Hours' (1865); 'On the Wing' (1860); 'Robert Brent's Three Christmas Days'; 'Lionel Wintour's Diary' (1882); 'A Colonial Boy' (1895); 'The Bright Side of Chinese Life' (1901); 'Opportunity and I' (1901); etc.

Eyth, Eduard, ĕd'oo-ārd īt, German poet: b. Heilbronn, Würtemberg, 2 July 1809; d. New Ulm 28 April 1884. He was author of a volume of 'Poems' (1843); 'Pictures in Frames' (1856); and a version of the 'Odyssey.'

Eytinge, ĕt'tĭng, **Rose,** American actress: b. Philadelphia 21 Nov. 1838. She made her début as an amateur in Brooklyn, N. Y., 1852, and the following year played through the West in a stock company. She has created many parts, including Rose Michel, Amande Chandoce in 'Led Astray,' and Felicia in the play of that name, but has been especially successful in her playing of Shakespearean roles, notably Cleopatra, Lady Macbeth, and Hermione (in the 'Winter's Tale'). She has written: 'It Happened This Way,' a novel; 'Golden Chains,' a play; and has dramatized Browning's 'Colombe's Birthday,' and Dickens' 'Dombey and Son'; 'David Copperfield'; 'Oliver Twist'; 'Tale of Two Cities,' and other works.

Eze'kiel, one of the greater Hebrew prophets. To him is attributed one of the larger prophetic books of the Old Testament, the visions and utterances which it contains being expressly attributed, in the work itself, to Ezekiel. He was the son of Buzi, a priest, and was carried captive, in the time of Jehoiachin, 595 B.C., about 11 years before the destruction of Jerusalem under Zedekiah. His prophecies are mostly in chronological order, those excepted which are launched against foreign nations. There is no direct quotation from Ezekiel in the New Testament, but there are a few allusions to his utterances, especially in the Book of Revelations, which, in the concluding portion, distinctly looks back to the temple arrangements prophesied in the last chapter of Ezekiel. The genuineness and authenticity of the prophecies of Ezekiel have not been seriously impugned either in the Jewish or Christian Church, and nearly universal suffrage has been given in favor of their canonicity.

Ezekiel, Book of, a series of prophecies, intended to warn and encourage the Hebrews during their captivity at Babylon in the 7th century B.C. The central point of the prophet's message is the destruction of Jerusalem, and his object is to call the people to repentance, to warn them against trusting in the help of Egypt (Ezek. xvii. 15-17), as a deliverance from the Babylonian yoke, and to assure them that the downfall of their city and temple was inevitable. At the same time, a future restoration is promised, and messages of consolation are mingled with denunciation and menace.

The whole book may be divided into nine main sections, as follows:

1. Ezekiel's call to the prophetic office.
2. The fulfilment of the commission symbolically outlined. Particular predictions of Jerusalem's destruction form the ground work of this vivid symbolism (Ezek. iii. 16,-vii.).
3. In a series of visions is revealed to the prophet the rejection of the people, because of their idolatrous worship. In these tableaux the temple is seen polluted by the worship of Adonis. But the denunciation of idolatrous priests and people is followed by promises of prosperity under a purer worship (Ezek. viii-xi.).
4. The sins, errors and prejudices of his contemporaries are rebuked in detail by the prophet (Ezek. xii.-xix.).
5. The especial and particular nature of the judgment, and the guilt that caused it, are unfolded in a series of thrilling denunciations, delivered about a twelvemonth later. The prophet announces that the judgment of God is drawing very near (Ezek. xx.-xxiii.).

6. He explains the significance of the now no longer impending, but actually commencing judgment. Jerusalem is being besieged, and the day when the siege began is announced to the captives. The city's complete overthrow is predicted (Ezek. xxiv.).

7. God's judgment against seven heathen nations is threatened (Ammon, xxv. 1-17; Moab, 8-11; Edom, 12-14; the Philistines, 15-17; Tyre, xxvi.-xxviii., 19; Sidon, 20-24; Egypt, xxix.-xxxii.).

8. A prophetic representation of the triumph of Israel and of the Kingdom of God on earth (Ezek. xxxiii.-xxxix.).

9. A symbolic representation, in whose glowing imagery the Messianic reign, and the establishment of God's Kingdom in power and prosperity are revealed (Ezek. xl.-xlviii.). Consult: 'Encyclopedia Biblica' (1903); also Cornill, 'Der Prophet Ezechiel Geschildert.'

Ezekiel, Moses Jacob, American sculptor: b. Richmond, Va., 28 Oct. 1844. He was graduated at the Virginia Military Institute 1866, having served in the Confederate army during the last year of his course. He studied art in Richmond and Cincinnati 1866–70, and Berlin, Germany, 1870–4, where he was the first foreigner to win the Michael Beer prize (1873). While there he studied under Prof. Albert Wolf, and was admitted to the Berlin Society of Artists on the merits of his colossal bust of Washington, now in Cincinnati. Later he went to Rome, Italy, where he has chiefly resided save for frequent visits to America. He has exhibited in the chief American and European expositions. Large and small, including statues, portrait-busts, ideal groups, and relievos. His works number several hundred of which the best known are: 'Cain, or the Offering Rejected,' an early ideal bust that showed considerable dramatic talent; 'Schiller and Goethe,' Berlin (1870); 'Religious Liberty,' Fairmount Park, Philadelphia (1874–6); bas-relief portraits of Farragut (1872), and Robert E. Lee (1873); 12 marble statues of artists for the Corcoran Art Museum, Washington (1880–2); marble busts of Beethoven (1884), and of Cardinal Hohenlohe (1888); bronze statue of Columbus in the Columbian Memorial building, Chicago, Ill.; statue of Mrs. Andrew D. White for Cornell University; bust of Lord Sherbrooke for Westminster Abbey; the fountain of Neptune for the town of Neptune, Italy, etc. In June 1903 the sculptor presented a bronze monument, 'Virginia Mourning Her Dead,' to the Virginia Military Institute.

Ez'ra, Jewish scribe and priest. Under his guidance the second expedition of the Jews set out from Babylon to Palestine under the reign of Artaxerxes I., about 458 B.C. The important services rendered by Ezra to his countrymen on that occasion, and also in arranging, and in some measure, it is believed, settling the canon of Scripture, are specially acknowledged by the Jews, and he has even been regarded as the second founder of the nation. Josephus states that he died in Jerusalem, and was buried there with great pomp; others assert that he returned to Babylon, and died there at the age of 120 years.

Ezra, The Book of, an Old Testament book, arranged in the English Bible between 2 Chronicles and Nehemiah. In the Thirty Nine Articles it is styled 'The First Book of Esdras.' The name Ezra, though commonly held to denote that he was the author of the book, however signifies no more than that the doings of Ezra are the main theme of the book, which is certainly the case. The period which the book spans is about 80 years, namely, from the first of Cyrus, 536 B.C., to the eighth of Artaxerxes Longimanus, 456 B.C.; the reigns embraced are those of Cyrus, Cambyses, Smerdis, Darius Hystaspis, Xerxes, and part of that of Artaxerxes. Both Jews and Christians consider the work part of the Scripture canon. It is written partly in Hebrew and partly in Chaldee, a fact which has led some to conclude that it is the work of different hands.

Ezra Church (Atlanta), **Battle of.** On 20 July 1864 the Confederate army under Gen. Hood was defeated at Peach Tree Creek, and driven into the inner defenses of Atlanta. On the 22d Hood attacked the Army of the Tennessee, and was again defeated, and Gen. Sherman began the investment of Atlanta. He began to force Hood from Atlanta by moving upon his communciations leading south from the city. The Army of the Tennessee was transferred from the extreme left of the investing line to the right, near Ezra Church, and Hood took measures to check its further extension and drive it back. On the night of the 27th he marched out of Atlanta with the greater part of his force, and on the 28th Gen. J. C. Brown's division was ordered to attack Logan's corps, then advancing on the right, and drive it back to and beyond Ezra Church. Brown drove in Logan's skirmishers, followed them 500 to 600 yards, and struck Logan's right, carried it at some points, but was quickly repulsed with great slaughter. He made a second attempt with no success and fell back. He had lost 694 killed and wounded and 113 missing. During Brown's attack four regiments from Dodge's and Blair's corps extended Logan's right, and took part in the action. Clayton's division attacked on Brown's right, but not until after Brown's first repulse, and by a misunderstanding his three brigades made isolated attacks upon Harrow's division, all of which were repulsed with great loss, some of the regiments losing 50 per cent. Walthall had led out his division while Brown and Clayton were engaged, and at 2 P.M., after they had been withdrawn, he was ordered to attack over the ground of Brown's fight. Walthall made several persistent efforts, but failed, although some parts of his force got within 50 yards of Logan's line. After more than an hour's severe fighting, in which he reports the loss of 152 officers and nearly 1,000 men, he fell back. At night Hood withdrew his troops to the works around Atlanta. The Federals in this battle numbered about 13,000 men; the Confederates about 18,000. The Union loss was 559 killed and wounded, 73 missing. The aggregate Confederate losses were apparently about 2,636 killed and wounded, and 200 missing. The estimates of Gens. Sherman, Howard, and Logan that the Confederate loss was from 5,000 to 7,000 are excessive. Consult: 'Official Records,' Vol. XXXVIII.; Cox, 'Atlanta'; Sherman, 'Personal Memoirs,' Vol. II.; The Century Company's 'Battles and Leaders of the Civil War,' Vol. IV.

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F

F the sixth letter of the English and Latin alphabets and all alphabets derived from the Latin. The character F, though it does not appear in the Greek alphabet of the classic period, had a place in the earlier Greek alphabet, and is believed to have there represented the sound of *v* or of *w*. It is called by Greek grammarians, digamma or double-gamma, being formed of two gammas (g hard, Γ) written one above the other (F). From the Greek it came into Latin and, finally, was used to express the sound which it has for us. That the sound of F in Latin was the same as in English, we know from what Quintilian says of the mode of uttering it. The Greek letter Φ (phi) represented in Latin and English by *ph*, appears to have been very different in sound from the F of the Latins; and that in the pronunciation of F Greeks found great difficulty is known on the authority of Cicero; their difficulty was like that which people of other speech than ours find in pronouncing th in then, this, and in thin, think. A like difficulty in pronunciation of the F of Latin must have presented itself to the inhabitants of the Spanish peninsula, if not in the time of Roman domination, then after; else the initial F of words from the Latin would not have been so generally changed by them into a mere breathing, represented by the letter h. Examples: Lat. *faba* (bean), Span. *haba; fabulari* (to talk), *hablar; facere* (to make), *hacer*. In other languages, whether derived from one another or springing independently from a common original stem, as German, Anglo-Saxon, Greek, Latin, Celtic, etc., we see a different interchange as between F and P: thus to the English word fish answers the Latin *pisc* (*piscis*); to Eng. fire the Gr. *pyr*; to Eng. plow the Ger. *pflug*. In the local dialect of the English county of Somerset, F usually becomes V: fair becomes vair, friar vrier, five vive. As the Latin alphabet had but one character, V, to represent both the vowel U and the consonant V (or W) the Emperor Claudius ordered that in public inscriptions and state documents this consonant V should be represented by the F inverted, Ⅎ, and hence in monuments of that reign we find AMPLIAⅎIT, TERMINAⅎIT, OCTAⅎIA, etc., for Ampliavit, Terminavit, Octavia, etc.

F. F. V.'s (First Family of Virginias), a jocular term applied in the North, before and during the war, to the Southern aristocracy in general.

Fa, fā, the name given by Guido to the fourth note of the natural diatonic scale of C, that is, the subdominant. In the major scale of C this tone is F.

Fabbri, fāb'rē, **Cora Randall,** American poet: b. New York 1871; d. there 1892. She was of Italian descent. A volume of her 'Lyrics' appeared but a few days before her death.

Fabens, Joseph Warren, American miscellaneous writer: b. Salem, Mass., 1821; d. 1875. Among his works are: 'The Camel Hunt,' a narrative of personal adventure; 'Facts about Santo Domingo'; and 'The Last Cigar,' a book of poems.

Faber, Frederick William, D.D., English theologian and hymn writer: b. Calverley, Yorkshire, 28 June 1814; d. Brompton, London, 26 Sept. 1863. He was a nephew of G. S. Faber (q.v.). He was educated at Balliol College, Oxford, where he came under the influence of John Henry Newman (q.v.), whom in 1845 he followed into the Roman Catholic Church. On becoming a Roman Catholic he founded a small community called Brothers of the Will of God, who three years later joined the oratory of St. Philip Neri. He afterward established a branch of this oratory at Brompton, with which he was connected till his death. His prose writings are numerous, but it is by his beautiful hymns that he is best known. Of these: 'Pilgrims of the Night,' and 'The Land Beyond the Sea,' are the most noted. See 'Life and Letters,' edited by Bowden (1869).

Faber, George Stanley, English theologian: b. Calverley, near Bradford, Yorkshire, 25 Oct. 1773; d. near Durham 27 Jan. 1854. Having been Bampton lecturer in 1801, he shortly after published his lectures under the title of 'Horæ Mosaicæ.' From the first he adopted evangelical views, and soon began to aid them by his pen, particularly by 'The Doctrine of Regeneration in the Case of Infant Baptism.' He was vicar successively of Stockton-upon-Tees, Redmanshall, and Longnewton, holding the last appointment 21 years, when he resigned it to become master of Sherburn Hospital. His principal writings, in addition to those already mentioned, are: 'A Dissertation on the Prophecies,' the most popular of all his works, having in 1818, only four years from its first appearance, reached a fifth edition; and the 'Difficulties of Romanism,' of which a third edition appeared in 1853.

Faber, Johann Lothar, German manufacturer: b. Stein, near Nuremberg, 12 June 1817; d. 1896. In 1760 he founded in his native town a manufactory of lead pencils, with only 20 hands employed. He made so many improvements in the manufacture that his factory gradually became the centre of that particular industry, and absorbed the trade of Germany and Austria. Particularly successful and profitable was the making of pencils of different grades, while his business capacity in distributing his goods did much to promote their popularity. He opened branches in great cities of Europe and the United States. In his factory at Noisy-le-Sec near Paris are employed more than a thousand operatives, and the Faber pencils are considered the best in the market.

Fabian, fā'bi-an, belonging or relating to the famous Roman family, or clan, the Fabian, used especially in the military phrase Fabian tactics, to denote tactics the chief point of which is to weary and exhaust the enemy. By such measures Quintus Fabius Maximus greatly harassed Hannibal in the Second Punic war.

Fabian Society, an English socialistic organization, having its headquarters in London, and with affiliated branches in most of the principal cities and towns of Great Britain and Ireland. The society includes in its ranks some very prominent writers on social economy, including Sidney Webb, and publishes ‹Fabian Essays,› and ‹Fabian Tracts.› In 1888 they began to hold public meetings. Above 700 lectures have been given in one year by members of the society. The Fabians aim to bring about the «emancipation of land and industrial capital from individual and class ownership and the vesting of them in the community for the general benefit»; «the extinction of rent»; and «the transfer to the community of the administration of such industrial capital as can be conveniently managed socially.» They also advocate female suffrage. There is a society of the same name in the United States, which issues a periodical called the ‹American Fabian.›

Fabié, François Joseph, frän-swä zhō-zef fä-byā, French poet: b. Durenque, France, 3 Nov. 1846. He filled important chairs in different colleges, attaining distinction as the author of ‹The Poetry of the Foolish Ones› (1879); ‹The Belfry›; etc., and by ‹Roupeyrac's Mill,› a rustic drama, and other plays.

Fabii, fā'bi-ī, **Arch of the,** a commemorative arch in ancient Rome at the entrance of the Sacred Way (Via Sacra) to the Forum Romanum. It was constructed about 120 B.C. by Quintus Fabius Maximus Allobrogicus in celebration of his victories over the Allobroges and Arverni. Its material was the calcareous Italian rock called travertin, and its design simple. Some few of the travertin blocks were excavated in 1882 not far from the site of the arch.

Fabius, fā'bi-us, the name of one of the oldest and most famous families of Rome, every member of which was massacred at Cremera 478 B.C., except QUINTUS FABIUS VIBULANUS, who became one of the decemvirate. Among the most noted of the family in later times are: FABIUS AMBUSTUS, dictator, 350 B.C.; FABIUS RULLIANUS, to whose name MAXIMUS was added, twice dictator, conqueror of the Samnites and Etruscans, 323–280 B.C.; FABIUS GURGES, son of the preceding, consul of Rome; FABIUS PICTOR, the first writer of Roman history, 3d century B.C.; FABIUS MAXIMUS VERRUCOSUS, considered the greatest of his family, surnamed «Cunctator,» «the Delayer» (see FABIAN), from his system of warfare. Died 203 B.C.; FABIUS MAXIMUS QUINTUS, son and next in office to the preceding, afterward consul; FABIUS MAXIMUS ÆMILIANUS, distinguished in the war of Persia and in Spain, consul 147 B.C.; FABIUS MAXIMUS SERVILIANUS, pro-consul for Spain, censor 126 B.C.; FABIUS MAXIMUS ALLOBROGICUS, consul 122 B.C.

Fable (Lat. *fabula,* a narrative, especially a fictitious one), in literature, a term applied originally to every imaginative tale, but confined in modern use to short stories, either in prose or verse, which are meant to inculcate a moral lesson in a pleasant garb. Imaginary persons, animals, and inanimate objects are introduced as the actors and speakers. The fables consist properly of two parts — the symbolical representation, and the application, or the instruction intended to be deduced from it, which latter is called the moral of the tale, and is indispensable to it.

Herder divides fables into (1) Theoretic, intended to form the understanding; thus a phenomenon of nature, as illustrative of the laws of the universe, is used to exercise the understanding. (2) Moral, which contain rules for the regulation of the will. We do not learn morality from the brutes, but view the great family of nature, and observe that she has connected the happiness of all living creatures with the unchangeable, eternal law of effort, and take example from the observance of this law by the lower orders of creation. (3) Fables of fate or destiny. It cannot always be made evident how one thing follows as a necessary consequence from another; here then comes in play that connection of events which we call fate, or chance, and which shows that things follow, at least after, if not from one another, by an order from above. Thus the eagle carries with her plunder a coal from the altar, which sets fire to her nest, and thus her unfledged brood becomes the prey of animals which she has already robbed of their young.

The oldest fables are supposed to be the Oriental; among these the Indian fables of Pilpay or Bidpai, and the fables of the Arabian Lokman, are celebrated. Æsop is well known among the Greeks, and was imitated by Phædrus among the Latin writers. Bodmer has published German fables of the time of the Minnesingers. The first known German fabulist is Stricker, who belongs to the first half of the 13th century, but the famous mediæval beast-epic of ‹Reinecke Fuchs› (see REYNARD THE FOX) has a much more remote origin. Boner, who lived at the close of the 14th century, shows in his ‹Edelstein› the true spirit of fable. Burkard Waldis may be mentioned in the 16th century. The most successful of German fable writers is undoubtedly Lessing. In the 17th century Gay among the English, and La Fontaine among the French, were distinguished. The writer last named made fable the vehicle of wit, and carried it to its highest stage of perfection. Among the most interesting modern productions in this department of literature the fables of the Russian, Ivan Kriloff, deserve special mention. See ALLEGORY; MYTH; PROVERB.

Fabliaux, fä-bli-ō (Fr. from the Lat. *fabula,* a narrative, particularly a fictitious narrative), in French literature, the short metrical tales of the Trouvères (q.v.), belonging for the most part in the 12th and 13th centuries. These productions were intended merely for recitation, not for singing, had as their principal subjects the current gossip and news of the day, and were epigrammatic and ironical in style.

Fabre, Amant Joseph, ā-mäṅ zhō-zef fābr, a French author: b. Rodez, France, 10 Dec. 1842 (or 1843). A drama, ‘Joan of Arc’ (1890), made his name most widely known; his other works being largely represented by such books as: ‘A Course in Philosophy’ (1870); ‘Washington, the Liberator of America’ (1882).

Fabre, Ferdinand, fār-dē-näṅ, French novelist: b. Bédarieux, France, 1830; d. Paris 11 Feb. 1898. He published: ‘Ivy Leaves,’ poems (1853); then the novels: ‘The Courbezons’ (1861); ‘Julien Savignac’ (1863); ‘My Uncle Célestin’ (1881); ‘King Ramiro’ (1884); and ‘Mr. John’ (1886). The remarkable novel, ‘Abbé Tigrane’ (1873), first won him great distinction; ‘Lucifer’ (1884); portraying the struggle among the clergy between Gallicanism and Ultramontanism, is doubtless his greatest work. Among his shorter stories are: ‘The Abbé Riotelet’ (1891); ‘Norine’ (1890); ‘Germany’ (1891), etc. ‘Ma Vocation’ (1889) is a volume of leaves from his student diary.

Fabre, François Xavier Pascal, fräṅ-swä zäv-yā päs-cäl, French painter: b. Montpellier 1 April 1766; d. there 16 March 1837. He was a pupil of David, and produced in 1787 a painting representing the ‘Execution of the Children of Zedekiah by order of Nebuchadnezzar,’ for which he received the great prize of the academy, and was sent as a pensionary to Rome. He was believed to have been secretly married to the countess of Albany, who on her death in 1824 made him her sole heir, and bequeathed to him valuable MSS. which had been left to her by Alfieri. Fabre gave them to the city of Florence.

Fabre, Jean Raymond Auguste, zhŏṅ rā-mŏṅ ōgüst, French poet, brother of Ferdinand Fabre (q.v.): b. Jaujac, France, 24 June 1792; d. Paris 23 Oct. 1839. He was prominent in journalism and wrote: ‘Caledonia, or the Patriotic War’ (1823); ‘Histoire du Siège de Missolonghi’ (1827); ‘La révolution de 1830’ (1833).

Fabre D'Eglantine, Philippe François Nazaire, fē-lēp fräṅ-swä nä-zār fābr dā-glŏṅ-tēn, French dramatic poet: b. Carcassonne 28 Dec. 1755; d. Paris 5 April 1794. Having gained the prize of the Eglantine in the Floreal games at Toulouse, he assumed the name of that flower as a surname. He now wrote several theatrical pieces, of which however only two, ‘L'Intrigue épistolaire’ and the ‘Philinte de Molière,’ were successful. The latter is still considered one of the best character-pieces of the modern French stage. He engaged with ardor in the Revolution, acting with Danton, Lacroix, and Camille Desmoulins. As deputy from Paris to the National Convention, he at first supported moderate principles, but afterward voted for the death of Louis XVI. without appeal, and was chosen a member of the committee of public safety. He afterward became suspected by the Jacobins, and being condemned to death was executed along with his colleague Danton (q.v.).

Fabretti, Raffaele, rä-fä-el'ä fä-bret'tē, Italian antiquarian: b. Urbino 1619; d. Rome 7 Jan. 1700. He was made papal treasurer by Alexander VII., and finally superintendent of the archives in the castle of San Angelo, which office he held till his death. Among his writings may be mentioned: ‘De Aquæductibus veteris Romæ’; ‘De Columna Trajani’; and ‘Inscriptionum Antiquarum Explicatio,’ in the last of which much light is thrown on the discoveries made by himself in the Catacombs.

Fabriano, Gentile da, jen-tē'lā dä fä-brē-ä'nō, Italian painter: b. Fabriano about 1370; d. Rome about 1450. His earliest work was perhaps the decoration of a chapel for Pandolfo Malatesta at Brescia. In 1423 he painted one of his best extant pictures, an ‘Adoration of the Kings,’ for the church of the Holy Trinity in Florence. To the same period belongs a Madonna with Saints (now in the Berlin Museum). A picture of the naval engagement between the fleet of Venice and that of the Emperor Barbarossa, which Fabriano painted for the Venetian senate, so pleased them that they conferred on him the dignity of a patrician and a pension of a ducat *per diem* for life. Fabriano next worked at Orvieto, but was called thence by Pope Martin V., who employed him in adorning the church of St. John Lateran with frescoes from the life of John the Baptist. Fabriano's pictures indicate a cheerful and joyous nature. He had a childlike love of splendor and rich ornamentation, but his coloring is never extravagant or meretricious.

Fabriano, Italy, city 20 miles northeast of Perugia. It is in the midst of mountain scenery, and in a fruit-growing region. This is the native place of the artist, Gentile da Fabriano (q.v.), a large number of whose paintings are preserved here in churches and in the city hall. Paper, parchment, gunpowder, glue, and felt-cloth are the chief manufactures. The paper and parchment factories were established in 1564. Pop. of the commune 21,000.

Fabricius, Hieronymus, hī-ĕr-ŏn'i-mus fā-brish'i-us (Ital. Fabrizio, Girolamo), Italian physician: b. Aquapendente 1537; d. Padua 23 May 1617. He studied at Padua under the celebrated Fallopius, whom he afterward succeeded in the anatomical chair, and had Harvey, the discoverer of the circulation of the blood, for a pupil. Harvey acknowledged that the discovery of the valves in the veins made by his master put him on the way of his discovery. During the lifetime of Fabricius his merit was fully recognized by the public and the state. His works were collected and published by Bohnius (1687).

Fabricius, Johann Albrecht, yō'hän äl'-breʜt fä-brēt'se-ös, German scholar: b. Leipsic 11 Nov. 1688; d. Hamburg 30 April 1736. He was versed in almost every department of human knowledge, particularly in philology and ancient literature, and understood the art of using these stores of erudition to the greatest advantage. He was professor of rhetoric and moral philosophy in the gymnasium at Hamburg. He published a ‘Bibliotheca Græca’ (1705–28); ‘Bibliotheca Latina’ (1697); ‘Bibliotheca mediæ et infimæ Ætatis’ (1734); ‘Bibliotheca Ecclesiastica’; ‘Bibliotheca Antiquaria’ (1713).

Fabricius, Johann Christian, Danish entomologist: b. Tundern in the duchy of Schleswig 7 Jan. 1743; d. Kiel 3 March 1808. He pursued his studies at Leyden, Edinburgh, and Freiburg, in Saxony, and under Linnæus at Upsal. Few scholars of that great man profited more by his instructions. His works upon entomology show the principles, the method, and even the forms of expression, peculiar to Linnæus, applied to the development of a new, happy, and fruitful train of ideas. From his intercourse with him he derived his first notions of his system of arranging insects according to the organs of the mouth; and he endeavored to persuade Linnæus to make use of it in the new edition of his 'Systema Naturæ.' Fabricius obtained the professorship of natural history in the University of Kiel, and in 1775 appeared his 'System of Entomology,' which gave to this science an entirely new form. Two years afterward he developed in a second work the characters of the classes and orders, and demonstrated in the *prolegomena* the advantages of his method. In 1778 he published his 'Philosophia Entomologica,' written upon the plan of the well-known 'Philosophia Botanica.' From this time till his death he was constantly occupied in extending his system, and in publishing it, under various forms, in works of different titles. He was appointed counselor to the king of Denmark, and professor of political and rural economy.

Fabricius, Gaius Luscinus, kā'yus fā-brish'us lū-sī'nus, Roman general: d. after 275 B.C. He was twice consul, and gained several victories over the Samnites and Lucanians and was famed for his integrity and contempt of riches. This was shown on the occasion of his embassy to Pyrrhus in 280 B.C., when he firmly withstood all the attempts of Pyrrhus to allure him into his service. When consul, he discovered to Pyrrhus a plot formed to poison him by his physician; and in gratitude Pyrrhus released the Roman prisoners without ransom. Fabricius was afterward censor, and endeavored to check the growing passion for luxury. He lived a simple life and died poor.

Fabrics, Names of. The names given to most fabrics are derived from cities, towns, and persons. Damask is from Damascus; satins from Zay in China; calico from Calicut, India; muslin from Mosul; drugget is from Drogheda, Ireland; cambric from Cambral; taffeta from a street in Bagdad; gauze from Caza; dimity from Damietta; jeans from Jean; duck from Torque in Normandy; serge from Xerga, a Spanish name for a peculiar woolen blanket; velvet from the Italian *vellute;* chintz from the Indian *chott;* blanket is called after Thomas Blanket, a famous clothier who lived in England in 1340.

Fabroni, or Fabbroni, fä-brō'nē, **Giovanni Valentino Mathias,** Italian scientist: b. Florence 13 Feb. 1752; d. Pisa 17 Dec. 1822. He left behind him a considerable number of valuable memoirs and treatises on matters relating to chemistry, agriculture, physiology, etc., of which the best known are 'Provvedimenti Annonarj'; his 'Discourses on National Prosperity'; on 'The Equilibrium of Commerce, and the Establishment of Custom-houses'; on the 'Effects of the Free Traffic in Raw Material'; on 'Rewards for the Encouragement of Trade'; on the 'Chemical Action of Metals'; on the 'Value and Reciprocal Proportion of Coins'; on the 'Scales and Steelyards of the Chinese'; on the 'Palaces of Spain'; and on the 'Ancient Hebrew People.'

Façade, fa-sad' (Fr. «the front of a building»), the face or front of any building, particularly its principal face or faces; generally used of a building of magnitude or importance. A back elevation is termed a rear façade. See ARCHITECTURE.

Facciolati, or Facciolato, Jacopo, yä'kō-pō fä-chō-lä'tē or -tō, Italian philologist: b. Toregia, near Padua, 4 Jan. 1682; d. Padua 26 Aug. 1769. He devoted the greatest attention to reviving the study of ancient literature; and, accordingly, undertook a new edition of a dictionary in seven languages, which was called the 'Calepin,' from the name of its author, the monk Ambrosius Calepinus. His pupil, Forcellini, assisted him, and the work was completed between 1715 and 1719. He now, in company with his industrious disciple, conceived the idea of a Latin lexicon, in which every word, with all its significations, should be contained and illustrated by examples from the classical writers, after the manner of the dictionary of the Cruscan Academy. This immense undertaking occupied them both for nearly 40 years. Facciolati directed the work, which was almost entirely executed by Forcellini. He left many Latin discourses which are characterized by Ciceronian elegances of style, but differ from their model by a precise brevity.

Face. See SKULL.

Face Wheel, called also **Contrate Wheel** and **Crown Wheel,** a wheel which has cogs projecting from the periphery at right angles to the plane of motion; as, in watches, the wheel situated nearest the crown and driving the balance.

Facetiæ, fa-sē'shĭ-ē (Lat. «witticisms»), a collection of humorous sayings or tales, witticisms, and jests. Among the earliest such is that known as 'Asteia,' generally attributed to Hierocles. Latin collections were common in the later Middle Ages, the most notable being the 'Liber Facetiarum' (1470) of Poggio Bracciolini. See JEST-BOOK.

Fachan, or Fatshan, China, in the province of Kwang-Tung; on the Tu-Kiang, about 20 miles west by south of Canton. Its chief manufactures are iron and steel products, bamboo, and rattan articles, embroideries, and porcelain. Its trade is in manufactured articles and the agricultural products of the surrounding country. Pop. 500,000.

Fachingen-water (Ger. *Fachinger Wasser*), a mineral water, from a spring near Fachingen, a village of the governmental district of Wiesbaden, Prussia. It is reckoned among the strongest alkaline acidulous waters of Germany, being marked by a large content of carbonic acid and bicarbonate of soda. It is transparent, with a temperature of 10° C., and is used in cases of bronchial catarrh, catarrh of the stomach, gout, and other troubles.

Facial Angle, an anatomical term for the angle contained between two imaginary lines, one from the most prominent part of the forehead to the anterior extremity of the alveolar process of the upper jaw, opposite to the incisor teeth; the other from the external auditory foramen to the same point, serving to measure the elevation of the forehead. The angle is of great service in ethnology, but its magnitude is not an infallible criterion of the intellectual capacity of an individual. It is sometimes called Camper's angle, because the celebrated Dutch anatomist Camper was the first to draw attention to the importance of this method of skull measurement.

Facial Nerve. The seventh cranial nerve in the cerebro-spinal axis forms the chief motor nerve of the face. It originates in a group of ganglion cells lying in the floor of the fourth ventricle in the medulla. The fibres pass out through the temporal-bone lying by the side of the auditory nerve in the middle of the ear canal, and are finally distributed to the chief muscles of the face. Affections of this nerve cause partial or total loss of power of the muscles of the face. See FACIAL PARALYSIS.

Facial Nerve Paralysis, paralysis of the motor nerve which controls the muscles of the face. The paralysis may extend to one or both cheeks; but, in most cases, when the cause has been treated recovery follows.

Facial Neuralgia, a painful affection involving the chief sensory nerve of the face; the trigeminal or fifth nerve. This neuralgia may involve any of the branches and, because of their wide distribution over the shoulder, back of the neck, scalp, and face may be felt in a number of locations. Very frequently the pain is in the jaw and is due to diseased teeth, toothache being a form of neuralgia of this nerve.

The pain may radiate from over the orbit, constituting supra-orbital neuralgia, or it may be distributed over the back of the head, constituting occipital neuralgia. Occasionally neuralgia of the fifth nerve gives rise to typical attacks of sick-headache. A particular variety which is extremely severe, and is supposably due to disease of the sensory ganglia of the fifth nerve, is known as tic-douloureux. Characteristic features of neuralgias of the face are the sudden shooting, darting pains, usually one-sided, unaccompanied with other constitutional disturbances. The cause is most frequently exposure to cold. From riding on the tops of omnibuses, sitting by the open windows of railroad-cars, or by any open window with a draft blowing through, persons are very frequently affected. At times anæmia, gout, and infection from bad teeth occasion facial neuralgia.

Treatment will depend largely upon the exciting cause. Heat, gentle massage, simple diet, and free movements of the bowels are general measures to be carried out. Occasional surgical intervention is necessary to cure tic-douloureux. The medical treatment of neuralgias of the face is technical and involves the use of remedies that are dangerous in the hands of laymen.

Facial Paralysis, a partial or total loss of power in the muscles of the face. One side of the face alone is usually affected. Paralysis may result from any disease of or injury to the facial nerve, either inside of the skull proper, or in its external distribution. Paralysis of the face very frequently occurs in apoplexies. Here the disease results from a disturbance of the nerve in its intracranial portion. It also is occasioned by disease in the middle ear, but is most frequent following exposure to cold, during which the external branches are involved. This latter form is termed Bell's palsy (q.v.). The symptoms of facial paralysis may vary according to the number of branches of the nerve that may be involved. In a complete case the paralyzed side is flat and expressionless, the mouth is drawn toward the well side, making the well side look as though it were contorted and diseased. The patient is unable to whistle, and may not be able to talk very clearly. The tongue may be protruded toward the well side. There may be inability to close the eyelids. Sensation is not involved. When the patient eats he may not be able to move the tongue on the paralyzed side of the mouth, and he cannot fill out his cheeks on the flat side. The electrical reactions of the muscles at first may not be affected, but later what is known as the reaction of degeneration sets in. Most cases of facial paralysis due to peripheral trouble, as well as Bell's palsy, recover of themselves; others, due to hemiplegia or to inflammation of the middle ear or to fracture of the skull, recover less frequently.

Treatment is by means of tonics — iron, strychnine, arsenic, and electricity. In intractable cases surgical anastomosis with other motor nerves may prove of service.

Facial Spasm. See TICS.

Factor (Lat. «a maker»). (1) An agent or substitute, especially a steward or agent of an estate, appointed by a landowner to manage the estate, collect rents, let lands, etc.; also an agent employed by merchants to transact business for them in other places, as to buy and sell, to negotiate bills of exchange, etc. He differs from a broker in that he is entrusted with the possession and disposal of the goods, property, etc., and may buy and sell in his own name. See AGENT. (2) In arithmetic any one of the integers the product of which is a given number. A prime factor is a factor which is also a prime number. (3) In algebra, any one of the quantities which, when multiplied, produce a given algebraic expression.

Factor of Safety. See STRENGTH OF MATERIALS.

Factories and Factory Inspection. During the reign of Edward III., the making of woolen cloths became an industry, and some of the phases of the factory system began to appear. This industry was fostered by Edward, and at the suggestion of Queen Philippa he invited one John Kempe, a Flemish manufacturer of textiles, to come to England with his skilled workmen, and promised them protection and assistance. Accordingly by act of Parliament, the woolen manufacturers were first established in England, in the town of Kendal, manufacturing the cloth that was known as Kendal-green. Previous to the time of Edward III., English wool was largely in demand on the continent, and now, the better to protect this new industry, Edward forbade the export of wool under the penalty of death, and obliged his people to wear, as he himself wore, only the natural cloth. From this time on by legislation and protection, England took care of its woolen industries, until the time of Elizabeth, when free importation of wool was permitted, and some historians point to the fact that during her reign the manufacturers made most rapid progress; charity schools and poorhouses were established, which in after years were to form a strong factor in the factory system, and ultimately to improve factory conditions. About this time improvements had been made in the stocking loom, a great demand for yarns springing up, and new materials were sought. The cotton wool, a new material in weaving, which was to be the most important in the modern factory system, was given its impetus. The iron manufacture by the middle of the 18th century had almost come to a stand-still, owing to the destruction of the forest woods, which were used for coal. In 1756, making iron by the use of pit coal was successful, and the manufacture of iron again began to be one of the principal industries. By the middle of the 18th century the first factory, in the present sense of the word, was built by Lombe Brothers. It was a silk-mill, and the first in which the motive power was supplied from the outside, and machinery did the work heretofore supplied by human hands. The power used was a water wheel. This naturally set inventive minds to work with a view to supplying like mechanism to other grades, and many inventions sprang up, particularly for using the cotton wool. Arkwright came to the front with his water-frame, so-called, because water was the motive power. There began a rapid development in spinning machines, which were first applied to cotton, and in this industry we have the explanation how the earlier triumphs of the factory system were won. In the beginning of the 19th century, the modern factory system became established and the child-labor question arose. As the mills were first established by the streams, so that wheels might be moved by water power, it often happened that labor could not be had in the vicinity. Application was made to the almshouse for children who were indentured or bound out at a fixed rate, and for a certain length of time. Forced to work whether sick or well, often 16 hours a day, and given nothing for breakfast but water porridge, these children were visited with serious epidemics, and the attention of the public was thus aroused. In 1802 the first factory act for the «Preservation of the health and morals of apprentices in cotton mills» was introduced by Sir Edward Peel, one of the large manufacturers of that time. All mills employing 3 or more apprentices, or 20 other persons, were subject to this act. The most important clause was that which fixed 12 hours as a working day, and prohibited work altogether from 9 P.M. to 6 A.M.

In the earlier years of the factory in the United States, each home had its spindles and loom to fill the needs of its own members, the flax and cotton being grown, spun, and wove by the individual householder, or the slaves on the plantations. England frowned upon all manufactures in her colonies, and would allow no machinery or parts of machinery to be brought to this country, but could not fetter the brain, nor forbid the inventive genius, and Slatter and his associates, who coming to this country in the latter part of 1700, brought with them the knowledge which in 1803 built in Massachusetts the first cotton-mill in America. The first mill to take cotton in its crude state and pass it through the different processes to the woven cloth, was erected in Waltham, Mass., in 1813. The first type foundry was built in Philadelphia in 1794. The first glass-house was constructed in Pittsburg in 1796. Other factories followed in rapid succession between 1796 and 1810.

The first factory inspection law was adopted in England about the beginning of the 19th century, as a result of the agitation caused by epidemics among children and women in factories, but it was not until 1819 that the law was made effective. The abuses became so great that the government was at last compelled to interfere in the interests of humanity. This began by asserting the right of the state to control industrial establishments, where women and children were employed, but this necessarily involved the freedom of men in making contracts. The law was intended more particularly to meet the evils of the apprentice system, but it did not extend to factories, where children residing in the neighborhood were employed. From time to time this act has been amended, and the authority of government extended, so as to make it generally effective for the protection of all labor. It was thus in England that the value of factory inspection was first determined by experience. Subsequently it was introduced into this country. Massachusetts was the first American State to adopt a law of that character.

To-day there are factory laws in the United States based on the Massachusetts laws, for the examination and approval of plans of factories, apartment and tenement houses, also for proper fire-fighting, means of egress, and sanitary provisions; regulating the employment of labor of women and minors in manufacturing, mechanical and mercantile establishments and workshops; guarding of machinery; the construction of safety appliances of elevators; ventilation of factories and workshops; provision of water-closets for the use of each sex employed in factories and workshops, and various other sanitary regulations; uniform hours for meals for women and young persons; communication between the engineer's room and each room where machinery is run by steam; proper safeguards at hatchways, elevator openings and well-holes in public buildings, factories and mercantile establishments; competent watchmen and red lights in hotels; prohibiting during working hours the locking of any inside or outside door of any building where operatives are employed; weekly payment of wages; and sundry other matters; the granting of licenses to make, alter, repair, or finish coats, vests, trousers or wearing apparel of any description in a room or apartment in a tenement or dwelling house; the examination of engineers and firemen, and the inspection of boilers, granting of licenses, and steam power to be used. Women are protected by law from overwork by their employers and children are excluded from factories until of proper age, and Massachusetts has been from the first, and continues to be, in the advance in factory inspection, and under this system her industrial establishments have become models for all the other States. It is a marked illustration of what such a law accomplishes for a community.

International Association of Factory Inspection.— The International Association of Factory Inspection was organized at Philadelphia in 1886, and includes Canada, and the States of Massachusetts, New York, New Jersey, Pennsylvania, Rhode Island, Connecticut, Maine, Michigan, Ohio, Minnesota, Illinois, Wisconsin, Missouri, and Indiana. Each of these several States holds an annual convention of its inspectors, who meet to compare notes of their work for the year, and as their proceedings are made public, each State may know the advancement the other is making in its labor laws.

The inspection laws of Massachusetts are enforced by the inspection department, comprising 35 members, assigned to the duty of the examination and approval of plans for the construction of school, and other public buildings coming under the provisions of the law, relative to means of egress and to prevent the spread of fire; the proper heating and ventilating of school and other public buildings and examination of buildings reported to be unsafe to life or limb. Relative to the employment of children under the laws of the Commonwealth of Massachusetts, Inspector-in-Chief Rufus R. Wade says, in his last report: «During my service as chief of this department, I have seen the gradual rise and progress of legislation relative to the employment of child labor. The development of the labor question brought to the attention of successive legislatures, facts in relation to the employment of children, and whether from motives of humanity, or from other considerations, the legislatures have from 1874, when the so-called 10-hour law was enacted, down to the session of the present year, thrown the safeguard of law around the child-workers, and protected them from the evils and dangers to which they were exposed by the cupidity or thoughtlessness of others.»

In 1876 an act was passed in Massachusetts prohibiting the employment of children under 10 years of age. In 1883 the limit was extended by providing that no child under 12 years of age should be employed during the hours in which the public schools were in session. Again in 1885 another change was made, which provided that no child under 12 years of age should be employed at any time during the day in which the public schools were in session. In 1888 these several statutes were repealed, and provisions were made that no child under 13 years of age should be employed at any time in any factory, workshop, or mercantile establishment, thereby raising the limit without any qualification to 13 years; the statute also providing that no such child should be employed except during the vacation of the public schools in the city or town where he resides, unless the person or corporation employing him, procured and kept on file a certificate and an employment ticket for such child as prescribed by law. Again in 1898 the limit was raised to 14 years, and providing that no child under 14 years of age can be employed at any time in a factory, workshop, or mercantile establishment, and no child under 16 years of age can be employed in a factory, workshop, or mercantile establishment unless the employer procures and keeps on file a certificate, and posts near the principal entrance a list of all such children employed. States that have adopted the factory inspection system have similar child labor laws, differing as to their age, to the age limit when they can be employed. In some kinds of manufacturing, especially in the textile- and cotton-mills, young children can be employed to advantage. The children enter the mills when very young and soon become experts in certain parts of the business, and by the time they become men and women are able to command very good wages. This custom is now practised to some extent by foreigners in mill districts, who make every attempt to get their children employed, not seeming to care as to age or education, and as soon as their children begin to earn good wages, the parents stop work and live upon what their children earn. The laws of the State of Massachusetts are very good in some respects as to child labor, but when a child lives in a town where there are no evening schools, and the child comes from a foreign country, and has attained the age of 14 years, the parents can procure a certificate for them, and they can be employed, not being able to read at sight and write legibly simple sentences in the English language. Evening schools are now maintained by law only in towns where there are 10,000 or more inhabitants. These children should be made to attend the public day school, but at the present time they cannot legally be compelled to attend school.

The Fifty-Eight-Hour Law.— In the State of Massachusetts children under 18 years and women cannot be legally employed more than 58 hours in a week in a factory, workshop, or mercantile establishment, and every employer must post in a conspicuous place the number of working hours each day of the week, the hours allowed for meals, the hours when starting and stopping work, and it becomes a part of the inspector's business to see that this is faithfully complied with. This has been the law of the State since 1894. Previous to that time, a week's work for children and women in factories and workshops was 60 hours a week, and still at an earlier time there was scarcely any limit to the hours of labor. From 1874 to 1894 10 hours a day, or 60 hours a week was the limit. In 1900 a law was enacted by the legislature prohibiting the employment of children under 18 and women over 58 hours per week in a mercantile establishment, and obliging the employer to post a notice stating the hours of work required of them for each day of the week, and the hours allowed for dinner or other meals. Before this date there was no limit to the hours required of a female after she was 18 years of age, and 60 hours a week was required of females under 18 years of age.

Employment of Illiterate Minors.— The definition of an illiterate minor in the Massachusetts laws is one who cannot read at sight and write simple sentences in the English language, no matter how well he can read or write in any foreign language. The law provides that every minor over 14 years of age, who resides in a city or town where there is an evening school maintained, and who cannot read at sight and write legibly simple sentences in the English language, must attend day or evening school, or he or she cannot be employed while the evening school is in session.

Pure Drinking Water to be Provided.— All manufacturing establishments in Massachusetts shall provide fresh and pure drinking water, to which their employees shall have access during working hours.

The Care and Custody of Elevators.— The carelessness of those who operate elevators, and who have the safety of human life in their care, seems to be the source of many accidents. In Massachusetts all elevators for the carrying of freight or passengers, running at a speed of more than 100 feet a minute, must be operated by competent persons not less than 18 years of age, and no other person shall operate, or have the care or charge of such elevator, and no elevator shall be operated by, or placed in charge of any person under 16 years of age, whatever less than 100 feet a minute may be its speed.

Sanitary Provisions in Factories and Workshops.— The laws of Massachusetts and other States that have factory inspection laws have the most rigid sanitary regulations, and are provided in the interest of comfort, decency, and health. These relate to factories, workshops, mercantile establishments, offices, school-houses, and public buildings. It is required that these buildings shall be kept free from all effluvia arising from drains and that they shall have a proper number of water-closets provided for persons of each sex. It is also provided that during working hours these buildings shall be ventilated, that the air may not become injurious to the health of the persons employed therein. It also provides that all dust from the grinding or polishing of metals be carried away through suction pipes.

The Inspection of Boilers and Engineers' Licenses.— The Massachusetts law as now enforced reads as follows: «It shall be unlawful for any person to have charge of, or to operate a steam-boiler or engine, except boilers and engines of locomotive motor-road vehicles, boilers in private residences, in apartment houses of less than five flats, boilers under the jurisdiction of the United States, boilers used for agricultural purposes exclusively, boilers of less than 8 horsepower, and boilers used for heating purposes, limiting the pressure to 15 pounds to the square inch, other than these boilers above excepted; the person in charge must hold a license granted after a thorough examination by the inspectors appointed for this duty, who are expert engineers.»

The Sweatshop System.— With the introduction of the sweating system in the United States came a revolution in the clothing industry which has left in its wake destruction and poverty; for prior to the introduction of this system there was not, as a class, a better-paid people than those engaged in the ready-made clothing trade. Looking backward only a few years we have the recollection of a movement in sympathy with a people who were being driven from Russia and other European countries. The first duty upon arrival was to procure means to provide food and shelter for themselves and families, and, being without funds, the task became a very complicated one. The inducement to learn a good trade was freely offered them, provided they would work cheap enough to warrant a sufficient return for the knowledge bestowed upon them. The custom in vogue was that the apprentice should give from one to three months at very small pay, giving from 12 to 16 hours as a day's work. The profits to contractors employing this class of help was, of course, enormous. The immense amount of available labor, of this class, to a new method of employment which is called the task system, and to which the term «sweating» system was aptly applied. The sweating system, if conducted in workshops located in buildings devoted exclusively to manufacturing purposes, would never have obtained its present prominence in the public mind; but the competition between the employers of labor under this system resulted in a complete revision of conditions; cheaper shops were secured; large quantities of work per day were imposed upon the employed, until finally the tenement of the contractor was made to answer the double purpose of home and shop. The crowded condition of these tenements, hardly sufficiently large for the accommodation of the family, was increased by the addition of the help to be employed. All traces of home privacy were obliterated, sanitary conditions became unmentionable, filth and disease abounded, and the health of the public became endangered. When these conditions were made plain to the people, fear overcame them and appeals to the State legislature for the prevention of this system of manufacture were made. These appeals led to the enactment of laws tending to restrict the manufacture of clothing in tenement houses. The first law enacted, like most which tend to elevate the conditions of those who are obliged to labor for their living, emanated from the legislature of Massachusetts. This law provided that any house, room or place, used as a dwelling, and also used for the purpose of manufacturing, should within the meaning of the law, be deemed a workshop. The law defines a workshop as meaning any premises, room, or place wherein manual labor is exercised by way of trade, or for purposes of gain, but the exercise of such labor in a private house by the family, if a majority of the persons therein employed are members of such family, shall not constitute a workshop. The law also contained a provision which was intended to prevent the importation into the State of garments which had been made under unhealthful conditions, and this was enforced until similar laws were enacted in other States, particularly in the State of New York, from which the majority of this class of clothing was produced. The law also provides that any family desiring to do the work of making, repairing, or finishing any coats, vests, trousers, or wearing apparel of any description, in any room or apartment, in any tenement or dwelling house, shall first procure a license, approved by the chief of the inspection department. Every room or apartment in which any garments are made, shall be subject to the inspection and examination of the inspectors, for the purpose of ascertaining whether the rooms or apartments are clean and free from any contagious nature. If the inspector finds evidence of infectious disease present he shall report to the local board of health.

The laws of Massachusetts require that no building which is designed to be used above the second story as a factory, or workshop, or mercantile, or other establishment, and has accommodations for 10 or more above the second story, and no building more than two stories in height shall be erected until a copy of the plans thereof has been deposited with the inspectors. Such buildings shall not be erected without sufficient egress and other means of escape from fire, properly located and constructed. Such inspector may require that proper appliances shall be provided in the floors, walls, and partitions of such buildings to prevent the spread of fire.

CHARLES E. BURFITT,
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Factory Acts. See CHILD-LABOR; LABOR LEGISLATION.

Factory Economics. From the primitive condition where each man must shift for himself, evolution leads to a state of society where the individual expends his energy upon some congenial occupation and exchanges his product for the diverse results of the work of others. The concentration of interest and skill on special trades enables the development of tools and machinery of a degree of complication which places them beyond the power of the workman to own or operate individually. Almost every form of constructive work is now carried on by groups of specialized workers, each proficient in but one task and requiring for the best results a large investment in buildings, machinery, and other equipments. Each man receives a daily wage depending remotely upon the momentary condition of trade in the product he assists to make, and generally reduced or cut off only after a protracted period of business stagnation. To successfully provide for a comparatively regular outlay for pay-roll, material, and factory expense from the irregular receipts from sales is the problem of factory management.

Expectation of Profit.—The promoter of a manufacturing enterprise must first demonstrate a prospective profit to the capital invested. Monopoly, as by patent, franchise, or arbitrary conditions; natural advantages of location, affording cheap power or raw materials, low cost of land with corresponding low rental or interest charge, convenient transportation facilities, a good labor market, proximity to place of principal sales, and superior design backed by persistent effort to keep the advantage, are all factors in the problem of expected profits. The cost of product is made up of the value of material and labor. In factory accounting this sum is known as the net or «prime» cost. In addition to this, factory work is done with the aid of a force of laborers, sweeps, stock handlers, crane men, power plant employees, pattern-makers, draftsmen, office men, and salaried officials whose work cannot generally be determined to be upon this or that particular «job,» though quite as much part of the cost of product as is the direct labor. Equally undistributable are the general expense account, and the cost of marketing, made up of advertising, salesmen's salaries, and collection expenses. If the estimated selling price affords a probable margin of profit above the total cost made up of all these items, the enterprise has a chance of success, which may be increased by the ability of the sales department to raise prices, and of the constructing department to reduce costs.

Factory Construction and Equipment.—Essentials for economical production are abundance of daylight, preferably from overhead and the north side, ample space for unfinished work convenient to machines where it is handled, «routing» arranged so that as nearly as possible all articles are carried in one direction from the place of entrance successively to the proper machines and rooms for storage of finished product, and suitable transportation facilities, such as traveling cranes, trolley conveyors, and industrial railways. Tools and supplies are stored in central locations, cared for by attendants, and issued under restrictions which will prevent waste and loss. Machines must be selected of such dimensions and capacities that they may be usually worked to their maximum. Modern practice drives all machinery at maximum rates, in order to earn its cost before better tools are invented. With reference to the working force, comfortable, clean, and pleasant surroundings are of actual cash value to the management in increased quantity and quality of product. A sufficiency of unskilled labor must be supplied to save the time and steps of the skilled men. The most expensive item about the factory, generally speaking, is labor; which should be economized by labor-saving devices wherever possible, except where the cost of the daily operation of improvements is greater than the amount paid for labor that might be so saved.

Starting the Plant.—A new factory is merely an aggregation of men and machines, and until this condition is passed the financial results will be disappointing. The intangible something that puts the balance on the right side of the old factory's ledger comes with the better acquaintance of the various heads and their individual employees, the gradual elimination of weak points in the equipment, the construction and adaptation of «jigs» for quickly and conveniently handling work, and the gathering of records of past performances which measure the progress or backsliding of each repetition job. The books of the general office show the results of the transactions of the company with stockholders and others. The records of the cost department account for pay-roll and merchandise expenditures in such detail as to show accurately the cost of operating the machines, discover petty losses, suggest promising opportunities for cost reduction, and compare recent work with previous jobs or with the work of other factories.

Direct and Indirect Expense.—To this end distinctive order numbers or symbols are assigned to each piece or class of work, and accounts opened with each, to which labor and material are charged, thus giving «prime» or «direct» costs; to these amounts are added charges determined by arbitrarily fixed rules designed to indicate that proportion of the general operating expense fairly borne by each particular order, and known as «burden» charges. The burden rate may be laid out to cover the total of expense outside of material and direct labor; or preferably separated, the first addition covering only that portion belonging to factory operation, in which case the cost so far found is the manufacturing cost, and is a proper charge against an outsider bringing shop work of a familiar kind and taking it away when done. In most cases further expense is incurred for royalties, freight, and insurance on shipments to purchasers, and with large machinery, erecting expense; also for the shipping and billing force. The addition of this total in the form of a second burden charge gives the cost of the completed and delivered goods. Finally, there is the selling expense, which advances the total cost of product so that a very short profit may bridge the gap to the total income from sales.

Classification of Indirect Expense.— A fundamental principle is to charge direct to the order whatever can be determined to have been used thereon. The indistributable items will form some or all of the following accounts:

Manufacturing Expense, a general division comprising the following: *Rent,* or charges such as interest on bonds or fixed dividends on preferred stock representing the actual value of the property occupied; *Shop Salaries,* foremen's and clerks' wages; *General Labor,* all unskilled or skilled men not directly employed in manufacturing, such as helpers, watchmen, crane tenders and teamsters; *Supplies,* as oils, waste, files, paint, etc.; *Power, Heat and Light,* comprising fuel, water rent, power plant labor and supplies, belt renewals, pipe repairs and kindred items; *Defective Work,* expenses due to replacing incorrect, defective and spoiled work, which chance alone causes to fall on one job rather than another. *Repairs,* conveniently divided among the four heads, Buildings, Machinery, Small Tools, and General.

Administrative Expense.— Salaries, of draftsmen, office force and cost clerks; *Office Expense; General Expense,* not otherwise assigned; *Interest and Discount; Legal Expenses; Traveling.*

Selling Expense.— Commissions, and salaries; *Advertising; Traveling; Reclamation.* All these accounts should be defined in writing so that charges may be made consistently. Often further subdivisions are desirable; or heads different from those given, which pertain more particularly to machine construction. Each invoice when approved for entry is posted to the proper account, together with amounts paid for work and materials where such pertain to these accounts, and general totals are taken off at the end of each month.

Three Ways to Distribute Indirect Expense.— The problem is to determine the amount to add to the prime cost of each production order, so that the sum of all the amounts so added will approximate the total of the manufacturing expense accounts to date. The easiest, but generally the most inaccurate way is to add a percentage to the direct labor cost. A better way is to base the addition on the time taken to do the job. The best is a combination of the two.

To explain: Suppose wages actually paid for productive work — «direct» labor — amounts to $10,000, and manufacturing expense to $12,500. By adding to the cost of each order a sum equal to 125 per cent of wages paid for direct labor the problem is solved. But by this method, a job done in two hours by a 30-cent man on an expensive machine tool would appear to cost the same as if done in six hours by a 10-cent boy, ignoring the fact that the boy used the tool three times as long as the man, during which time the interest on first cost, depreciation, rent and heating expense went on at the usual rate, while the power used was probably no less, and the wear and tear perhaps more than with the more experienced man. The method is correct only for manufacturing operations done by men at equal wages on tools of equal value. By the second method, assuming that the $10,000 was paid to 180 men working 250 hours each, or 45,000 hours; the expense total of $12,500 being therefore equal to about 28 cents per hour, the job just instanced would be estimated to cost by the man $1.16, and by the boy $2.28. This method is correct where men earning various wages use tools all alike, but inaccurate where, as is usually the case, different employees use apparatus varying from a few hand tools to a $10,000 machine. The exact method is to divide the expense accounts into two classes, and apportion those which like light, heat, superintendence and clerk's wages belong equally to all the workmen, by a man-hour-rate found by the second method, and those which like power, repairs, rent and depreciation, etc., belong properly to the machines, by special tool-hour-rates based on careful study of the expense of operating each tool. Thus, suppose with the same hypothetical figures that $2,500 is found to be the total of the first class of expenses, or an hour-rate of 5½ cents for the 45,000 hours; while a large chucking machine carries as its monthly burden the value of space occupied at $30, interest and depreciation at 15 per cent on its cost of $2,000, making $25, 10 horse-power for its operation, costing $25, and other charges similarly determined to be $30, or a total of $110, distributed over a month averaging 150 hours running time, consequently at an hour rate of 73 cents. Rates being similarly determined for each machine or hand-work equipment, the cost of a one-hour job by a 30-cent man on this hypothetical chucking machine would be 30 + 73 + 5½ cents, or $1.08½, while the same piece, if it could be made by a 10-cent boy in three hours on an engine-lathe with an hour-rate of 20 cents, would cost 30 + 60 + 16½ cents, or $1.06½. The exact method here reveals that the expensive tool on this particular piece is saving nothing, and must show up better on other work or be arranged for use on more jobs. If run for the full shop time of 250 hours per month, its burden-rate would fall to 44 cents, and the supposed job would become profitable.

Convenient Simplification of Burden-charge. —In practice it is entirely satisfactory, after working out the man-hour and tool-hour rates, to combine and modify such as fall close together into two, three, or at most four class-rates; thus deciding that all work by hand on certain small machines shall carry Class A burden of, say, 10 cents per hour, another lot of larger tools Class B rate of, say 25 cents, and so on. This compromise gives good results, enabling the management to say definitely whether any particular job or class of product is paying for its real cost. Manufacturers using flat burden rates bid too low on work which, by reason of using their heaviest equipment, is unprofitable at the prices secured, and too high on work which employs mostly cheap labor and tools and would pay well at a lower figure. To determine truly the relative profits of different kinds of work it is advisable to apportion selling expense in a similar way, estimating the cost of selling each class and size of products and charging in the form of a percentage burden-rate on the gross cost of the goods.

Cost, Profit, and Selling Price.—Sub-totals of the cost of the month's completed work are credited on the general ledger, labor to «pay-roll,» material to «merchandise,» and burden to «distribution,» while the corresponding charge is made to «manufacturing account.» On the other side of the latter appears the total price received from or charged to customers for completed work. If the burden rates are modified, as is necessary from time to time to keep the distribution account approximately equal to the total expense account, the excess of the credit side of the «manufacturing account» shows the profit made by the sale of the product.

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Faculties, Court of, an English ecclesiastical court, under the archbishop, which creates rights to pews, monuments, and particular places and modes of burial, and has also various powers in granting licenses of different descriptions, as a license to marry, a faculty to erect an organ in a parish church, or to remove bodies previously buried.

Faculty, in ecclesiastical law, a privilege or license granted to any person by favor, and not as a right to do any act which by law he may not do. In the Roman Catholic Church, permission granted by an ecclesiastical superior to a duly qualified subject to hear confessions. Such permission only extends to the district over which the superior has jurisdiction. Thus, faculties are granted by bishops to the priests in their dioceses, and by the heads of religious houses to such of their subjects as they judge qualified to hear the confessions of the community. In the United States, the term faculty indicates the body of persons who are entrusted with the government and instruction of a university or college as a whole, comprising the president, professors, and tutors. It is also used for the body of masters and professors of each of the several departments of instruction in a university; as, the law faculty, etc.

Fadeyev, Rostislav Andreievitch, Russian military writer: b. 1824; d. Odessa 12 Jan. 1884. He made more than one campaign in the Caucasus; achieving a reputation as a scientific soldier that commands respect for his 'Russian Military Power' (1868); 'My Opinions of the Oriental Problem' (1870); 'Letters on Russia's Present Position' (1881); and many similar writings.

Fadienskoi, a Russian island of the Arctic Ocean, in the province of Yakatsk. It is 100 miles long by about 40 broad. The climate is very cold the greater part of the year; but the island is inhabited.

Fæces, the residue of food, combined with the intestinal secretions, as it passes from the body. After chyme has passed into the large intestine it is then termed fæces. During health fæces consist largely of the undigested portions of the food taken into the body. They contain microscopically many epithelial cells from different parts of the intestinal canal; shreds of mucus, bits of meat-fibre, the character of which depends upon the ingested food, and which can be determined by the microscope; vegetable detritus consisting largely of parenchymatous and vascular tissues, plant-hairs, etc.; fat-globules; bacteria of many kinds; bile pigments; and other organic residues. As the chemistry of the fæces will vary widely according to the diet, charts of chemical composition are worthless. The consistency of the fæces also widely varies. Normally, fæces should be semi-solid; if too hard, constipation is probable; if too soft and watery, indigestion may be present, or some degree of colitis (q.v.). Large quantities of mucus indicate a colitis. The color of the fæces is of much importance in determining whether the normal functions of the intestine are being carried on. In health the fæces should vary from a light to an umber brown, white to yellow fæces indicating lack of bile-excretion or loss of fat-digestion. Very black fæces often result from excessive bile-elimination, but such are more likely to be present when the drinking-water contains small amounts of mineral constituents, notably iron. Many drugs modify the color of the fæces. In children, green to greenish stools indicate either the presence of certain pigment forming bacteria, or they mean that there is excessive fermentation or putrefaction of the intestinal contents, leading to excess of oxidation of the bile-pigments: In either case castor oil is an excellent corrective. Tarry fæces, resembling coffee-grounds in color, usually indicate the presence of blood high up in the intestinal canal. If bleeding occurs in the large intestine or rectum, red is the prevailing tinge. Small quantities of blood color the fæces orange, like paprika. Cocoa and huckleberries cause a coloration of the fæces that may be mistaken for blood. Colorless or gray-colored stools usually indicate some form of biliary obstruction; or, perhaps from fatty indigestion, an excess of fat passed either from lack of bile-emulsion action or from loss of fat-absorption. Children taking cod-liver oil often have light-colored stools. These should be carefully studied to determine if digestion of the oil is taking place. Disturbance of the functions of the pancreas may also cause light-colored or fatty stools. The study of the color of the stools is of immense practical importance in medicine, and careful observation of this matter by the patient may be of immense service to the physician. See INTESTINES. Consult Conner, 'Medical News' 30 Aug. 1902.

Faed, fād, **John,** R.S.A., Scottish artist: b. Burley Mill, Kirkcudbrightshire, 1820; d. Gatehouse-of-Fleet, Scotland, 22 Oct. 1902. In 1841 he went to Edinburgh to study, soon won a considerable reputation, and was elected associate of the Royal Scottish Academy in 1847, becoming full academician four years afterward. In 1851 he exhibited a work entitled 'The Cruel Sisters,' and this was followed by 'The Cotter's Saturday Night' (1854); 'The Philosopher' (1855); 'The Household Gods in Danger' (1856); 'Job and his Friends' (1858); and 'Boaz and Ruth' (1860). Going to London in 1862, he began to exhibit in the Royal Academy also, some of his pictures shown since that date being: 'Catherine Seyton' (1864); 'Old Age' (1867); 'John Anderson, my Jo' (1869); 'After the Victory' (1873); 'The Morning before Flodden' (1874); 'Blenheim' (1875); 'In Memoriam' (1876); 'The Old Basket-Maker' (1878); and 'The Poet's Dream' (1882). His work invariably displays careful drawing, but his coloring is somewhat hard.

Faed, Thomas, Scottish artist: b. Burley Mill, Kirkcudbrightshire, 8 June 1826; d. London, 22 Aug. 1900. He was a brother of John Faed (q.v.), and at an early age became known as a clever painter of rustic subjects. The subjects of his brush are for the most part domestic or pathetic, and in these he has attained a success that emulates that of Wilkie. Among his principal works are: 'Sir Walter Scott and his Friends' (1849); 'The Mitherless Bairn' (1855); 'The First Break in the Family' (1857); 'Sunday in the Backwoods' (1859); 'His Only Pair' (1860); 'From Dawn to Sunset' (1861); 'The Last o' the Clan' (1865); 'Pot Luck' (1866); 'Worn Out' (1868); 'Homeless' (1869); 'The Highland Mother'

(1870); 'Winter' (1872); 'Violets and Primroses' (1874); 'She Never Told her Love' (1876); and 'Maggie and her Friends' (1878).

Faenza, fä-en'zä (ancient FAVENTIA), Italy, city, in the province of Ravenna, 19 miles from the city of Ravenna. It is noted for its glazed earthenware, called Faience (q.v.), the manufacture of which has flourished here for centuries. Others of its manufactures are majolica, silk goods, and refined sulphur. In the neighborhood are ferruginous and saline springs of considerable repute. Faenza is connected with the Adriatic by the Zanelli Canal, opened in 1782. It claims to be the birthplace of Torricelli. Its history extends into the times before the Christian era, and many changes in government took place before 1509, when it was annexed by Julius II. to the States of the Church. In 1860 it became a part of the Kingdom of Italy. Pop. 13,998; of the commune, 40,400.

Faerie Queene, The, a famous metrical romance by Edmund Spenser, dedicated to Queen Elizabeth, and published in 1590. The poet was already known by his 'Shepherd's Calendar,' but the appearance of the first three books of the 'Faerie Queene' brought him fame. The last three books appeared in 1595–6. The poem is an allegory, founded on the manners and customs of chivalry, with the aim of portraying a perfect knight.

Faeroe Islands. See FAROE ISLANDS.

Fafnir, fäf'nēr, in the mythology of the Nibelungenlied, a son of the magician Hreidmar. In the form of a dragon he guarded the gold which was paid in atonement for the death of Otr, and was slain by Siegfried.

Fagel, fä'ʜĕl, **Frans Nicolaas,** Dutch soldier: b. Nimwegen 1645; d. Shiys 23 Feb. 1718. He was a nephew of Gaspar Fagel (q.v.), entered the military service in 1672. He distinguished himself in the battle of Fleurus 1690, and the famous defence of Mons 1691 was directed by him. He also displayed great military talent at the siege of Namur, at the capture of Bonn, and in Portugal 1703, in Flanders 1711 and 1712, at the battles of Ramillies (1706) and Malplaquet (1709).

Fagel, Gaspar, Dutch statesman: b. The Hague 1629; d. there 15 Dec. 1688. He was one of the negotiators on the part of Holland in the Peace of Nimwegen (1678), to the conclusion of which he appears to have been personally opposed. He contributed, as much as his position enabled him to do, to the enterprise of William of Orange upon England, and prepared the expedition by which he was enabled to take possession of the crown of that country, although he did not live to witness the success of the undertaking.

Fagerlin, fä'gėr-lēn, **Ferdinand Julius:** b. Stockholm 5 Feb. 1825. In 1854 he began his art studies and entered the Academy of Stockholm; thence he passed to Düsseldorf, and finally became a pupil of Couture at Paris. From Düsseldorf he started on a professional journey northward, for the purpose of studying sea and coast life in Holland. The pictures he then painted are true to nature, subtile in characterization, and abound in wholesome humor.

Fagin, fä'gin, a despicable Jew in Dickens' 'Oliver Twist.' He is represented as training up children in crime in order to profit by their thievish practices, and condemned to be hanged for receiving stolen goods.

Fagnani, fän-yä'nē, **Joseph,** Italian painter: b. Naples, Italy, 1819; d. 1873. He studied at Vienna and Paris, and came to the United States with Sir Henry Bulwer in 1849; here he painted 'The Nine Muses' (portraits of New York women), now in the Metropolitan Museum. He also painted many European celebrities.

Fagot, a bundle of sticks or small branches of trees bound together. In times of religious persecution, the fagot was a badge worn on the sleeve of the upper garment of such persons as had abjured heresy, being put on after the person had publicly carried a fagot to some appointed place, by way of penance. Among military men in England, fagots were persons hired by officers whose companies were not full, to muster and hide the deficiencies of the company, and thus cheat the government.

Fagot-vote, in Great Britain, is a vote procured by the purchase of property under mortgage, or otherwise, so as to constitute a nominal qualification without a substantial basis. Fagot-votes are chiefly used in county elections. The way in which they are usually manufactured, namely, by the purchase of a property which is divided into as many lots as will constitute separate votes, and given to different persons, has given rise to the name. Sometimes properties are bought in this way, and held for the sake of the vote.

Fagot-worm, a caterpillar of a moth of the genus *Eumeta,* which in Ceylon is common on the coffee-trees. It forms a pupa case of silk covered with small sticks, so that it looks like a bundle of fagots; and local folk-lore explains that these worms are the abode of the souls of persons who in their lifetime were thieves of firewood. These moths are related to the bag-worm moths (q.v.).

Fagotto, fạ-got'tō, a brass wind instrument, blown with a reed, which can be taken in pieces and carried like a bundle of fagots, hence the name; a bassoon (q.v.).

Faguet, Emile, ā-mēl' fä-gā', French critic: b. La Roche-sur-Yon, France, 17 Dec. 1847. He has published 'French Tragedy of the 16th Century' (1883); 'Corneille' (1888); 'The Great Masters of the 17th Century' (1885); 'Madame de Maintenon as a Teacher,' etc.

Fagus, the typical genus of the Beech family (*Fagaceæ*). The genus has four species, natives of the Northern hemisphere, only one of which, the common beech (*F. americana*), is native of the United States. All the species are trees with smooth gray bark and serrate leaves, the flowers and leaves appearing together. The name is from the Greek, to eat, referring to the edible nuts. See BEECH.

Fahaka, an edible globe-fish (*Tetraodon fahaka*), singular in inhabiting the fresh waters of the Nile. See GLOBE-FISH.

Fahlcranz, fäl'krānts, **Karl Johann,** Swedish landscape-painter: b. Sprengel, Stora-Tuna, in the lān of Falun, 29 Nov. 1774; d. Stockholm 1 Jan. 1861. Studying nature diligently, he became a self-educated artist. He was acquainted only with northern scenery, but has given it with great fidelity and spirit. His

FAIENCE

From Strassburg

Persian Faience

Old German Jug

From Rouen

Hirschvogel Pitcher

Delft Ware

Modern English Faience

Modern French Faience

principal productions are in the possession of the king of Sweden.

Fahrenheit, fä'ren-hīt, **Gabriel Daniel,** German physicist: b. Dantzic 14 May 1686; d. Amsterdam 16 Sept. 1736. He settled in Holland, where in 1720 he first conceived the idea of using quicksilver instead of alcohol in thermometers — a discovery by which the accuracy of the instrument was very much improved. He took, as the limit of the greatest cold, that which he had observed at Dantzic in the winter of 1709. The space between the point to which the quicksilver fell at this temperature, and that to which it rose in boiling water, he divided into 212 parts. About 1724 he discovered the fluctuation of the boiling point of water, which he had made one of the fixed points of his thermometer. Fahrenheit's thermometer owed its beginnings to the invention of a thermometer by Newton, described in the 'Philosophical Transactions' for 1701. Newton's instrument was a tube filled with linseed oil, and the starting-point of the scale was the temperature of the human body, which Newton called 12. Newton divided the space between his datum and the freezing-point of water into 12 equal parts, and stated that the boiling-point of water would be about 30 of these degrees on the scale. Fahrenheit, when he began to work with Newton's thermometer, did not find the scale minute enough for his purposes. He therefore first doubled the number of degrees, making the scale number 24 instead of 12. Finding he could, by mixing ice and salt, obtain a temperature below freezing, Fahrenheit next adopted this for his starting-point and counted 24 degrees up to body heat, making the freezing-point 8 and calling boiling water 53. Later on he again divided his degrees into four. It will be seen that if the above figures are multiplied by four, the result is the thermometric scale called after him which is still in use.

Faidherbe, Louis Léon César, loo-ē lā-ôṅ sā-zär fā-därb, French general and author: b. Lille 3 June 1818; d. Paris 29 Sept. 1889. Entering the army in 1840, he became lieutenant in 1842. From 1854 till 1861, and again from 1863 till 1865, he was governor of Senegal, in which capacity he considerably extended the French possessions there. After the fall of Napoleon III. he was summoned by the government of National Defense to France and appointed commander of the army of the north. In the latter part of his life he went on a mission to Egypt to study the monuments and hieroglyphics. He wrote valuable monographs on Senegal, the Sudan, and other parts of Africa, including 'L'Avenir du Sahara et du Sudan' (1863); 'Collection Complète des Inscriptions Numidiques' (1870); 'Nouvelles Inscriptions Numidiques' (1872); 'Langues Sénégalaises' (1887); and 'Le Sénégal: la France dans l'Afrique Occidentale' (1889). On the Franco-German war he published 'Campagne de l'Armée du Nord en 1870–1' (1872).

Faience, fā-äṅs, glazed pottery. The name is derived from the town of Faënza in Italy and was applied to pottery by the French under the following circumstances. About the year 1578 the Duke of Nevers in France was desirous of establishing an atelier for the production of glazed pottery and he secured a skilled workman named Gambyn. This man was an Italian and had learned his art in Faënza. When, therefore, he produced similar pottery at Nevers it was known as Faënza ware and, subsequently, as faience, a Gallicized form of the word. The term is now generally applied to ornamental pottery of which the glaze forms a marked feature. Faience is distinguished from porcelain by the fact that it is produced at a much lower temperature, being made, for the most part, of common and often colored clays. Most of the decorative pottery produced in America falls within this class, as for instance the Rookwood, Grueby, Merrimac, and Volkmar wares. The term faience is not usually applied to any form of tableware though there seems to be no good reason why plates should be classed apart from vases if they are similar in technical quality. See CERAMICS; POTTERY.

Faillon, Michel Etienne, mē-shel ā-tē-en fä-yôṅ', French historical writer: b. Tarascon, France, 1799; d. Paris 25 Oct. 1870. He was a Sulpician and visited Canada in 1854 to investigate the houses of that order. He wrote lives of noted French Canadian religionists, and a comprehensive history of the French in Canada, three volumes of which appeared before his death.

Failure. See BANKRUPT.

Fainéants, fā-nā-äṅ, or **Do-nothing Kings,** the name given in French history to some of the Merovingian sovereigns, who were the puppets of the mayors of the palace. The last of these kings was Childeric III.

Faint (syncope), a peculiar form of sudden loss of consciousness. Impoverishment of the blood, lowered vitality from any cause, an overwrought nervous system, and disease of the circulatory system predispose to such attacks. The immediate cause is an anæmia of the brain. This sudden cerebral anæmia is most frequently due to shocking sights, sickening smells, pains, or fears. The attack may be ushered in by a period of nausea, sighing respiration, or "faint feeling." Immediate lowering of the head below the rest of the body will frequently ward off further trouble. Most commonly the attack is very sudden, the face becoming absolutely bloodless and having a deathlike calm; the pulse is weak or imperceptible, the breathing very shallow. In true syncope spasms are not present, neither is voiding of the urine or fæces. Fatal termination is rare, consciousness ordinarily being restored in a few moments if prompt measures are taken. The patient must be placed in a recumbent position, with the head as low or lower than the rest of the body; constricting clothing should be loosened; and water may be slapped on exposed parts. Smelling-salts held to the nose are of value. Later mild stimulants may be used to restore normal condition; but resumption of vertical position should be postponed as long as practicable.

Faioum, or **Fayoum.** See FAYUM.

Fair, James Graham, American capitalist: b. near Belfast, Ireland, 1831; d. San Francisco 1894. He emigrated to America in 1843 and went to California in the famous '49 year. He amassed great wealth by mining in Nevada, to which he went in 1860. He was elected in 1881 as a Democrat to the United States Senate in which he served one term.

Fair God, The, a romance by Lew Wallace 1873. It is a story of the conquest of Mexico by the Spaniards, its scene laid upon Aztec soil, in the early part of the 16th century. The title is derived from Quetzalcoatl, «the fair god,» the Aztec deity of the air.

Fair Haven, Mass., town in Bristol County on Buzzard's Bay, at the mouth of the Acushnet River, and on the New York, N. H. & H. R.R.; 60 miles south of Boston, and opposite New Bedford, with which it is connected by bridges. Here are the Millicent Public Library, several banks, churches, and other public buildings. It has manufactories of glass, castings, nails, and tacks. Many buildings of architectural merit, which render Fair Haven one of the most attractive towns of the State, were erected by Henry H. Rogers (q.v.) as memorials to members of his family. One architectural group, a fine example of Tudor architecture, consisting of a church and two other buildings, is considered a model of beauty. Pop. (1910) 5,122.

Fair Havens (Gr. Καλοὶ Λιμένες, *Kaloi Limenes*), an anchorage on the southern coast of Crete, five miles east of Cape Litino. It is of small size and amply sheltered from western winds. The only mention of it by ancient writers is that by Paul (Acts xxvii. 8), whose well-known shipwreck occurred after departure from Fair Havens for Phenice or Phœnix. It is probable that there was no town at that point, although, as stated in Acts, Lasea was but a short distance away.

Fair Head, or Benmore, a precipitous promontory of the north coast of county Antrim, Ireland, opposite Rathlin Isle. It rises 636 feet above the sea, and consists of carboniferous strata, overlaid by greenstone columns, 20 to 30 feet thick, and 280 to 300 feet high.

Fair Isle, a solitary Shetland island lying midway between Shetland and Orkney, and 30 miles southwest of Lerwick. It is three miles long and two miles broad. The men employ themselves chiefly in fishing, and the women in knitting the well-known Shetland hosiery. They are said to have acquired this art from the Spanish seamen whose ship, belonging to the Armada, was wrecked here in 1588. Pop. 223.

Fair Maid of Perth, The, a novel by Sir Walter Scott, published 1831. The time is the reign of King Robert III. of Scotland; whose scapegrace son David, the crown prince, is the connecting link in the story between the nobility and the burgher-folk of the city of Perth. Like all Scott's novels, 'The Fair Maid of Perth' contains fine descriptions of scenery, and stirring accounts of battle; and unlike many of his plots, this one allows the «course of true love» to run comparatively smooth.

Fair Oaks and Darbytown Road, Engagement at (SECOND BATTLE OF FAIR OAKS)—On 27 Oct. 1864, Gen. Grant began a movement on the Petersburg lines, to seize the South-side railroad, and as a support to the movement, had ordered Gen. Butler to make a demonstration north of James River on Richmond. Parts of three divisions of the Tenth corps, under Gen. Terry, six brigades of the Eighteenth corps, under Gen. Weitzel and Gen. Kautz's cavalry division were designated for the movement. Terry was to make a demonstration along the Darbytown road, under cover of which Weitzel was to push through White Oak Swamp to reach the Williamsburg road and seriously threaten Richmond. The columns started from camps, near Chaffin's farm, very early on 27 October. Terry reached the Darbytown road, a part of his command crossed over to the Charles City road and advancing on both roads, a little before 8 A.M. engaged the Confederates in their entrenchments from the New Market road to the Charles City road. Weitzel, after a march of 16 miles, crossing both the Darbytown road and Charles City road and at 1 P. M. reached the Williamsburg road at Heintzelman's old works, on the battlefield of 31 May 1862, and pushed at once down the road one and a half miles toward Richmond, and came upon the Confederate works, which appeared to be feebly held by a small body of dismounted cavalry and three guns. Weitzel prepared to attack, first sending a brigade of colored troops across the York River railroad to find and turn the Confederates' left near the New Bridge road. The defenses north of the James were held by Gen. Longstreet, with the divisions of Gens. Hoke and Field, some «local defense» troops, under Gen. Ewell, and Gen. Gary's cavalry brigade. These were posted with reference to defense along the river roads. As soon as Longstreet detected Weitzel's movement he ordered Field's division to move to the left and it formed on either side of the Williamsburg road. It was 3.30 P.M. when Weitzel, with two brigades, and others in support, advanced on either side of the road, over open ground, and was met with an unexpected heavy fire of musketry and artillery. His troops almost reached the works, but were repulsed with a severe loss, in killed, wounded, and missing. Soon after dark Weitzel withdrew after losing over 1,000 men. While Weitzel was engaged, Terry, at 4 P. M., was ordered to press his demonstration and carry the entrenchments. He made the attempt and was repulsed. On the next day the expedition returned to camp. The Union loss was 905 killed and wounded, and 698 missing. The Confederate loss was comparatively small; Field's division and Gary's brigade reported 64 killed, wounded and missing. The entire loss probably did not exceed 100. See Humphrey, 'The Virginia Campaign of 1864–5.'
E. A. CARMAN.

Fair Oaks (Seven Pines), Battle of. After the battle of Williamsburg (5 May 1862) the Army of the Potomac, under Gen. McClellan, advanced cautiously up the Peninsula, established a base at White House, and 20 May his advance crossed the Chickahominy at Bottom's Bridge, and the entire Fourth corps under Gen. E. D. Keyes crossed on 23, taking position 25 May at Seven Pines, on the main road to Richmond, about five miles distant. The Third corps, under Gen. S. P. Heintzelman, crossed 25 May. This left on the north bank, the Second, Fifth and Sixth corps, commanded respectively by Gens. E. V. Sumner, Fitz John Porter, and Wm. B. Franklin. McClellan began to rebuild destroyed bridges and to perfect communication between the two wings of his army, astride the Chickahominy. The movements of McClellan north of the Chickahominy and information from his cavalry, convinced Gen. Joseph E. Johnston, the Confederate commander, that Gen. McDowell with a strong corps was about to join McClellan from Fredericksburg, upon which, 28 May, he ordered up Gen. Huger's division from Petersburg and Drewry's Bluff and suggested to Gen. Lee that every available command should be concentrated at Richmond. On 25 May Gen. Casey's division of the Fourth corps advanced from Seven Pines to Fair Oaks, about three fourths of a mile and threw up works covering the road, and on 30 May two brigades of Kearny's division. Third corps, were advanced about a fourth of a mile in front of Savage Station to within supporting distance of Casey. Gen. Couch's division, Fourth corps, was at Seven Pines, and Gen. Hooker's division, Third corps, on the border of White Oak Swamp. Johnston, from his works, three miles in front of Richmond, watched McClellan's cautious advance. A reconnoissance 30 May developed the fact that Keyes had advanced his lines to Fair Oaks; Johnston saw his opportunity and issued orders for an attack next day. The Army of the Potomac, 31 May, had 127,166 officers and men, of whom 98,008 were present for duty, and it had 280 guns. Johnston had about 63,000 effectives and was not well supplied with artillery. Johnston purposed to throw 23 of his 27 brigades against Keyes and Heintzelman and with four brigades along the line of the river from New Bridge to Meadow Bridge prevent the rest of McClellan's army from crossing the stream. He purposed to move the 23 brigades by the Charles City, Williamsburg, and Nine Mile roads, crush Keyes' corps and drive it back in disorder on Heintzelman, and capture or destroy those two corps before any assistance could reach them from the north bank of the stream. There was some misunderstanding of orders on the morning of the 31 and much consequent delay but, at noon, Gen. D. H. Hill's division of four brigades, deployed in double line on either side of the Williamsburg road, advanced on Casey's division at Fair Oaks and after a severe fight of two hours drove it back upon Couch's division at Seven Pines. Hill now received a reinforcement of one brigade, and two brigades of Kearny's division came to the assistance of Couch and Keyes, and the struggle was renewed at Seven Pines, with the result that the entire Union force was driven back to a line of entrenchments about a mile in the rear, which position was held. Three Union divisions had been engaged and suffered severely, and a part of Couch's division had been cut off. Gen. G. W. Smith, with several Confederate brigades, was observing the Chickahominy, under orders to engage any troops that might cross the stream to assist Keyes and Heintzelman, or, if none came, he was to fall upon the right flanks of the Union lines engaged. After waiting some time and believing that no Union troops would cross to the south bank of the stream, Smith put some of his troops in motion to make the flank attack, but it miscarried from the timely arrival of Sumner on the south bank of the Chickahominy. Sumner, who was nearest Keyes and Heintzelman, heard the sound of battle at 1 o'clock and was at once in the saddle, and ordered his troops under arms. A little later orders came from McClellan that he should be prepared to march at a moment's notice. Without waiting another moment he marched his two divisions to the Chickahominy and paused upon the two bridges, waiting orders to cross them. At 2.30 P. M. the order came to cross. Richardson could get but one brigade of his division over the lower bridge and was obliged to move up and follow Sedgwick's division over the Grapevine Bridge, which swayed and tossed in the river. But the solid column of Sedgwick's infantry, loading it with a weight with which even the angry Chickahominy could not trifle, soon pressed and held it down among the stumps of the trees, which in turn prevented its lateral motion. Once across, Sumner pressed forward on the road, deep with mud, toward Fair Oaks, and came up to Couch, who with four regiments and a battery had been cut off from his division and was holding ground about a half mile from Fair Oaks, with Smith approaching to make his flank attack. But four of Sumner's regiments had formed on Couch when Smith attacked, two more soon followed, and these six regiments, with Couch's, checked all efforts of Smith's four brigades to dislodge them and saved the day at Fair Oaks. Richardson's division came up at nightfall and formed on Sedgwick's left, extending toward a brigade of Heintzelman's corps, while Hooker, coming to the support of the defeated troops on the Williamsburg road, filled vacant spaces in the line. There were now three corps across the Chickahominy in continuous order, ready for action when day should dawn. Near the close of the day Gen. Johnston, the Confederate commander, was severely wounded and relinquished command to Gen. G. W. Smith. On the morning of 1 June, the Union army awaited attack, which was delivered by the Confederates and, on some parts of the line, the fighting was severe, but the advantage remained with the Union troops, who regained most of the ground lost the previous day. On 1 June, Gen. R. E. Lee was placed in command of the Army of Northern Virginia, but did not take direction of affairs on the field until the fighting was over, and 2 June withdrew to the fortifications around Richmond from which Johnston had advanced 31 May. The Union forces engaged at Fair Oaks numbered about 36,000; the Confederates about 32,000. The Union loss was 4,384 killed and wounded, and 647 missing; the Confederate loss was 5,729 killed and wounded, and 405 missing.

Consult: Allan, 'The Army of Northern Virginia in 1862'; 'Battles and Leaders of the Civil War,' Vol II.; McClellan, 'My Own Story'; Michie, 'Life of Gen. McClellan'; 'Official Records,' Vol. XI.; Walker, 'History of the Second Army Corps'; Webb, 'The Peninsula.'

E. A. CARMAN.

Fair Trade, an expression used in Great Britain by certain persons who, professing to be free traders, would still tax goods imported from any country which refuses to accept the principles of free trade. Free traders consider this view as protectionist. They hold that if they can import goods cheaper from a protectionist country than elsewhere, they should be free to reap that advantage even if they cannot export their own goods to that country free of duty. See FREE-TRADE.

Fairbairn, Andrew Martin, English theologian: b. near Edinburgh 4 Nov. 1838. Having qualified for the ministry of the Evangelical Union, he was appointed to a church of that denomination at Bathgate in 1860. Accepting a similar charge in Aberdeen in 1872, he ministered there till appointed in 1877 to the principalship of Airedale Independent College, Bradford. On the foundation of Mansfield College, the Congregational Theological College at Oxford, in 1886, he was appointed principal, a post which he still occupies. He delivered the Aberdeen Gifford Lectures of 1892–4, and the Lyman Beecher Lectures at Yale in 1892. His most important works are: 'Studies in the Philosophy of Religion and History' (1876); 'Studies in the Life of Christ' (1881); 'The City of God' (1882); 'Religion in History and in Modern Life' (1884, revised and enlarged edition 1893); 'Christ in the Centuries' (1892); 'The Place of Christ in Modern Theology' (1893); 'Catholicism, Roman and Anglican' (1899).

Fairbairn, Sir **William,** Scottish civil engineer: b. Kelso, Scotland, 19 Feb. 1789; d. 18 Aug. 1874. He entered business in Manchester, England, in 1817. He constructed the first iron ship in England and afterward his firm built over 100 iron vessels. He was associated with Robert Stephenson in designing and building the great tubular bridge over Menai Strait. He was the author of 'Mills and Millwork'; 'Iron, Its History and Manufacture'; 'Application of Iron to Building Purposes'; 'Iron Shipbuilding'; 'Useful Information for Engineers'; 'An Experimental Inquiry into the Strength, Elasticity, Ductility, and other Properties of Steel' (1869); etc.

Fairbank, Calvin, American clergyman: b. Pike, N. Y., 3 Nov. 1816; d. Angelica, N. Y., 12 Oct. 1898. He was an ardent abolitionist, and during 1837–9, aided 23 slaves to escape across the Ohio River. In 1843 he raised $2,275 to secure the liberty of a nearly white slave girl who was to be sold at auction at Lexington, Ky. In 1844 he opened the way for the escape of the Hayden family, for which offense he suffered five years' imprisonment. Later he was again detected in violation of the Fugitive Slave Law, and sentenced to 15 years' imprisonment at Frankfort, where he was cruelly treated, receiving about 35,000 lashes on his naked body. In 1864 he was set at liberty after spending more than 17 years in jail. He published 'How the Way Was Prepared' (in which he told the story of his own life).

Fairbanks, Arthur, American teacher and author: b. Hanover, N. H., 1864. He was graduated at Dartmouth College in 1886, and received a doctorate from Freiburg, Germany. He has taught at Dartmouth, Yale, and Cornell, and since 1900 has been professor of Greek literature in the State University of Iowa. Among his writings is an 'Introduction to Sociology' (1901) which has been translated into Japanese.

Fairbanks, Charles Warren, American lawyer and senator: b. near Unionville Centre, Union County, Ohio, 11 May 1852. His father, Lorison M. Fairbanks, was a Vermonter, and was one of the early pioneers who settled in the west in 1836 and helped to hew out of the wilderness the great Buckeye State. The son's earliest life was spent in toil on the farm, from sunrise to sunset, and in quiet hours of study during the evening. He was naturally studious, and early destined himself to the career of a lawyer. After passing through the district school he attended classes in the Ohio Wesleyan University, where he was graduated with distinction in 1872. During his senior years at college he edited the 'Western Collegian,' the college journal. After leaving the Wesleyan University he went to Cleveland, as Associated Press agent; meanwhile studying law. In 1874 he was admitted to the bar of the supreme court of Ohio at Columbus, and in the same year removed to Indianapolis, Ind. In this city he has lived ever since, as a practising lawyer. While never holding public office until elected to the Senate, he was chairman of the Indiana State Convention in 1892 and again in 1898. In 1893 he was unanimously chosen as the nominee of the Republican party for United States senator, but was defeated at the polls by the Democratic candidate, David Turpie, although receiving his entire party vote. He was delegate-at-large to the Republican National Convention at St. Louis in 1896, and was temporary chairman of the convention. He was appointed a member of the United States and British Joint High Commission, which met in Quebec in 1898 for the adjustment of Canadian questions, especially relating to the seal-fisheries of Alaska. He was elected to the United States Senate 30 Jan. 1897, and at the expiration of his term was re-elected. In Nov. 1904 he was elected Vice-President on the Republican ticket. Since 1885 he has been a trustee of the Ohio Wesleyan University.

Fairbanks, Henry, American inventor: b. St. Johnsbury, Vt., 6 May 1830. He is a son of Thaddeus Fairbanks (q.v.), and was graduated at Dartmouth College in 1853, and at Andover Theological Seminary in 1857. He was ordained in 1858; held pastorates in Burke and Barnet, Vt., and in 1859 was professor of physics, and later of history, at Dartmouth. He became identified with the manufacturing firm of E. & T. Fairbanks & Co., in 1868; and subsequently gave much of his time to mechanical experiments, and patented several inventions relating to the manufacture of scales.

Fairbanks, Thaddeus, American inventor: b. Brimfield, Mass., 17 Jan. 1796; d. St. Johnsbury, Vt., 12 April 1886. He settled in St. Johnsbury in 1815, and there worked with his father in a saw and grist mill, and also in the manufacture of carriages. In June 1831 he patented the platform scales bearing his name. Afterward about 50 different improvements were made on these scales, which have been sold in all parts of the world.

Fairbury, Nebr., city, county-seat of Jefferson County; on the Little Blue River, the St. Joseph and other branches of the Chicago, R. I. & P. System; about 60 miles southwest of Lincoln. It is situated in a good agricultural region, and its chief manufactures are flour and dairy products. A large nursery is just outside the city limits. Pop. (1910) 5,294.

Fairchild, Ashbel Green, American clergyman; b. Hanover, N. J., 1 May 1795; d. Smithfield, Pa., 1864. He wrote many contributions to the religious press. His most popular work, 'The Great Supper,' was translated into German and had an immense sale. He also published 'Baptism'; 'Faith and Works'; and 'Confession of Faith.'

Fairchild, Charles Stebbins, American financier; b. Cazenovia, N. Y., 30 April 1842. He was graduated at Harvard University in 1863; admitted to the bar in 1865; became deputy attorney-general of New York in 1874, and attorney-general in 1876. After spending some time in Europe he settled in New York city in

1880, where he practised law till 1885. He was assistant secretary of the treasury 1885–7, and secretary 1887–9. Subsequently he became president of the New York Security and Trust Company.

Fairchild, George Thompson, American educator: b. Brownhelm, Ohio, 6 Oct. 1838; d. 1901. He was graduated from Oberlin College 1862, and from Oberlin Theological School 1865; was professor of English literature Michigan Agricultural College 1879–97; and was vice-president of Berea College from 1898. He entered the Congregational ministry in 1871 and published 'Rural Wealth and Welfare: Economic Principles Illustrated and Applied in Farm Life' (1900).

Fairchild, Herman Le Roy, American educator; b. Montrose, Pa., 29 April 1850. He was graduated at Cornell University in 1874; was secretary of the New York Academy of Science in 1885–88; became president of the Rochester Academy of Science in 1889, secretary of the Geological Society of America in 1890, and vice-president in 1898. He has been professor of geology at the University of Rochester from 1888, and has published a 'History of the New York Academy of Sciences' (1887).

Fairchild, James Harris, American educator: b. Stockbridge, Mass., 25 Nov. 1817; d. 1902. Was elected president of Oberlin College in 1866, after a service of 26 years as tutor, professor of languages, professor of mathematics, and professor of moral philosophy and theology. Besides editing the 'Memoirs of Charles G. Finney' (1876) and Finney's 'Systematic Theology' (1878), he was the author of 'Moral Philosophy' (1869); 'Oberlin, the Colony and the College' (1883); 'Elements of Theology, Natural and Revealed'; and 'Woman's Right to the Ballot' (1870). He resigned the presidency of Oberlin in 1889.

Fairchild, Lucius, American military officer: b. Kent, Ohio, 27 Dec. 1831; d. Madison, Wis., 23 May 1896. At the beginning of the Civil War he enlisted as a private in the Federal army, and in August 1861, was appointed a captain in the regular army, and major in the volunteer army. He took part in the battles of Bull Run and Antietam, and led the charge up Seminary Hill at Gettysburg, where he lost his left arm. He was promoted brigadier-general in 1863, but resigned to serve as secretary of state of Wisconsin. He was afterward elected governor, and served six consecutive terms. In 1886 he was chosen commander-in-chief of the Grand Army of the Republic.

Fairfax, Donald McNeill, American naval officer: b. Virginia 19 March 1821; d. Hagerstown, Md., 10 Jan. 1894. During the Mexican war he participated in the capture of Mazatlan and Lower California. In 1861 he had personal charge of the transfer of Messrs. Mason and Slidell and their secretaries from the «Trent,» a British mail ship, to the «San Jacinto.» He later took part in the chief naval operations in Charleston harbor; was promoted rear-admiral 11 July 1880; and retired 30 Sept. 1881.

Fairfax, Edward, English poet: b. Denton, England, about 1580; d. near Otley, England, January 1635. He made a metrical translation 'Godfrey of Boulogne' (1600), of Tasso's 'Jerusalem Delivered,' and dedicated it to Queen Elizabeth; it was highly esteemed by James I., and is still highly valued; and on this rather than on his own «Eclogues» the fame of Fairfax as a poet rests. He is also author of a 'Discourse on Witchcraft,' first published in 1858.

Fairfax, Thomas, Lord, English general: b. Denton, Yorkshire, 17 Jan. 1611; d. Nun Appleton, Yorkshire, 12 Nov. 1671. Fairfax warmly espoused the cause of Parliament, and in April 1642, presented to Charles a petition of the people imploring him to be reconciled to his subjects. The same year he was appointed general of the horse, and in 1644, together with Essex, Waller, and Manchester, he held a chief command in the English army sent to co-operate with the Scots. The credit of the battle of Marston Moor has, by some authorities, been divided between Leslie and Cromwell, but, according to others, Fairfax is also entitled to share in it. On the Earl of Essex resigning the command of the parliamentary army in 1645, Fairfax was made general-in-chief in his room. He insisted on the command of the horse being given to Cromwell. When he took Oxford the first thing he did was to set a guard upon the Bodleian Library, an act for which he deserves the gratitude of posterity. He subsequently, in November 1647, was engaged with Cromwell in putting down the levellers in the army, and in the following year captured Colchester, and caused Sir Charles Lucas and Sir George Lisle to be tried by court-martial and shot. Being ordered to march against the Scottish Presbyterians, he positively declined the command and Cromwell was appointed (June 26, 1650) to succeed him. He was appointed one of the lay church commissioners in 1654, and was a member of Cromwell's first Parliament. He assisted Monk against Gen. Lambert, and co-operated in the restoration of Charles II., being one of the committee charged to secure his return.

Fairfax, Thomas, 6th Baron of Cameron: b. England 1691; d. Greenway Court, Frederick County, Va., 12 Dec. 1782. He was educated at Oxford and was a contributor to Addison's 'Spectator.' He came to America and settled on a vast landed estate in Virginia inherited from his mother, a daughter of Lord Culpeper. It was there, at Greenway Court, that Washington first met him, and between the two there sprang up a warm friendship.

The 11th Lord Fairfax and baron of Cameron who succeeded his brother to the baronetcy in 1869, and who died in Northampton, Md., 28 Sept. 1900, like his American predecessors, made no claim to the title.

Fairfield, Sumner Lincoln, American author: b. Warwick, Mass., 25 June 1803; d. New Orleans, La., 6 March 1844. He began the publication of the 'North American Magazine' in 1833; and continued to edit and publish it for five years. His published volumes include: 'Lays of Melpomene' (1824); 'Cities of the Plain' (1828); 'Poems and Prose Writings' (1840), and 'Select Poems' (1860).

Fairfield, Conn., town, port of entry, in Fairfield County; three miles southwest of Bridgeport; on the Long Island Sound, the New York, N. H. & H. R.R. The chief manufactures are paper, rubber goods, and machinery. It has good public buildings, two libraries, and four buildings which date from Revolutionary times. The first settlement was made in 1869 and the town was incorporated the same year. It was the scene of several Indian and Revolutionary battles, and in 1779 was almost wholly burned by the Hessians and Tories. Pop. (1910) 6,134. Consult: Osgood, 'Centennial Commemoration of the Burning of Fairfield.'

Fairfield, Ill., city, county-seat of Wayne County; 123 miles southeast of Springfield; on the Louisville, E. & St. L. and the B. & O. Southwestern R.R.'s. The manufactures are chiefly flour, lumber, and dairy products. The trade is in agricultural products. It is the site of the Hayward Collegiate Institute. Pop. (1910) 2,479.

Fairfield, Iowa, city, county-seat of Jefferson County; 48 miles northwest of Burlington; on the Chicago, R. I. & P. and the C., B. & Q. R.R.'s. The principal manufactures are brooms, tile, agricultural implements, machinery, furniture, carriages, flour, and dairy products. The electric-light plant and the water-works are owned by the city. The Parsons College, under the auspices of the Presbyterian Church, was founded here in 1875. The first settlement was made in 1839. Pop. (1910) 4,970.

Fairhaven, Wash., before 1903 a city in Whatcom County; now part of Bellingham; 42 miles northeast of Victoria, in Canada, and 88 miles north of Seattle; on the Northern P. and the G. N. R. R.'s. It is near a good agricultural region; its principal manufactures are canned salmon, tin cans, flour, and lumber. Fairhaven was first settled in 1888. Its natural advantages combined with its opportunities for railroad transportation make its outlook most promising. See BELLINGHAM.

Fairholt, Frederick William, English artist and author: b. London 1814; d. there 3 April 1866. He published: 'Costume in England: a History of Dress to the Close of the 18th Century' (1846); 'The Home of Shakespeare Illustrated and Described' (1847); 'Remarkable and Scientific Characters' (1849); 'Dictionary of Terms in Art' (1854); etc.

Fairmont, W. Va., city, county-seat of Marion County; on the Monongahela River and the Baltimore & O. R.R.; 75 miles southeast of Wheeling. It is the site of a State Normal School; its principal manufactures are glass, machinery, cigars, lumber, and iron products. It has considerable trade in coal, coke, and manufactured articles. Pop. (1910) 9,711.

Fairmount College, a coeducational preparatory school and college, under the auspices of the Congregationalist Church. It was established in 1892, with assistance from the Boston Education Society. A collegiate department was added in 1895. In 1910 there were 23 professors and instructors, 341 pupils, and 23,000 volumes in the library.

Fairmount Park. See PHILADELPHIA.

Fairs and Periodical Markets. A fair is a periodical meeting of merchants in an open market held at a particular place, and generally for the transaction of a particular class of business. The origin of fairs is obviously to be traced to the convenience of bringing together at stated times the buyers and sellers of the stock-produce of a district. Fairs are generally held in or near towns, but from their nature are specially adapted to the convenience of country dealers and their customers. Two curious facts are to be noted in the history of fairs. In Europe the numerous festivals of the church afforded the most favorable opportunity for the establishment of these markets. This association is indicated in the German name of a fair, which is identical with that used for the ceremony of the mass. A fair generally brings a concourse of people into the town in which it is held, and gives it something of a holiday appearance. Advantage has frequently been taken of this concourse, either by the persons assembled themselves or by the purveyors of various amusements, to add entertainment to business, and as the business of a particular fair declined it has often, instead of being abandoned, been gradually converted into a periodical opportunity for a saturnalia of amusement. Thus religion, business, and diversion have come to be associated in the idea of a fair.

In the Middle Ages fairs were specially privileged and chartered by princes and magistrates, special temporary tribunals were even established for their use. It was then the custom, which in some places still remains, to make a public proclamation of the commencement and duration of the fair. The goods sold at fairs were then of much greater value, as well as variety, than at present, embracing fabrics of all kinds, as well as jewelry. In some parts of the Continent the practice still prevails of purchasing clothing at fairs. Fairs existed in ancient as well as modern times, and are to be found in all parts of the world. In the East they are of great magnitude and importance. At Mecca, during the annual pilgrimages, and at Hardwar in Ajmîr, a resort of pilgrims in Hindustan, two of the greatest fairs of the East, we find again the association between commerce and religion. According to Prescott fairs were regularly held in the principal cities of Mexico every fifth day, being the recognized substitute for shops. A fair for the sale of slaves was held at Azcapozales, near the capital. At the principal fair, held at the City of Mexico, the number of visitors reached 40,000 to 50,000. Here the same arrangement prevailed as in the European fairs of the Middle Ages. A court of 12 judges, clothed with absolute authority, maintained perfect order in this great concourse.

The Easter and Michaelmas fairs at Leipsic, the fairs of Frankfort-on-the-Main, of Lyons in France, and Nijnei-Novgorod in Russia, are among the most important fairs of the present day in Europe. The fairs of Great Britain now mostly consist of the weekly market-days of country towns, and certain great agricultural meetings, or trysts, as they are called in Scotland, chiefly for the sale of cattle and horses, such as the Falkirk Tryst. There are also, especially in Scotland, a considerable number of the hiring fairs. Among the most celebrated of the fairs which have been turned into saturnalia are the celebrated Donnybrook fair in the county of Dublin; Bartholomew and Greenwich fairs, London; and Glasgow fair. The day of these fairs is, however, already past; the tide of modern improvement has long since reached the amusements of the people, and better means of entertainment are now available. In the United States the State fair and county fair, as well as the church fair, are established institutions. See EXHIBITIONS.

Fairweather, Mount, in Alaska, 35 miles northeast of Cape Fairweather. According to accurate observations its height is 14,900 feet above the level of the sea. It is covered with perpetual snow.

Fairy, an imaginary being or spirit of diminutive size, supposed generally to assume a human form, but appearing also in others, and represented as both beneficent and malevolent toward mankind. In the latter case diseases of cattle were frequently attributed to their mischievous operations; and cattle that died suddenly without any apparent cause were commonly said to be elf-shot. Among the Irish peasantry they are termed «the good people» by way of placation. In Poole's ‹Parnassus› are given the names of the fairy court: «Oberon, the emperor; Mab, the empress; Perriwiggin, Perriwinkle, Puck, Hobgoblin, Tomalin, Tom Thumb, courtiers; Hop Mop, Drop, Pip, Drip, Skip, Tub, Tib, Tick, Pink, Pin, Quick, Gill, Ion, Tit, Wap, Wim, Nit, the maids of honor; Nymphidia, the mother of the maids.» Croker, in his ‹Fairy Legends and Traditions of the south of Ireland,› describes them as beings «a few inches high, airy, and almost transparent in body; so delicate in their form that a dewdrop, when they chance to dance on it, trembles, indeed, but never breaks.» They are supposed to live in a distinct domain known as Fairyland, and their character and habits as represented in literature may best be learned from the Irish lore and such works as the ‹Märchen of the Grimms›; Spenser's ‹Faerie Queene,› and Shakespeare's ‹Mid-summer Night's Dream.› Belief in fairies has existed from earliest times, and formed part of the superstition of nearly all peoples. Consult: Keightley, ‹The Fairy Mythology› (1850). See FOLK-LORE; MYTHOLOGY; PARACELSUS; also such titles as ELVES, KOBOLD, and the like.

Fairy Bluebird, one of the bulbuls (q.v.) of the East Indian family *Pyenonotidæ* and genus *Irena,* familiar in Indian gardens, and justly admired. The commonest species is brilliant turquoise, with black wings, tail and under parts, and coral-red legs and beak. They make a rather rough little nest in a bush and lay two or three speckled eggs.

Fairy Ring, or **Circle,** a ring occasionally observed in pastures, distinguished from surrounding vegetation by being either barer or more luxuriant, and attributed by the peasantry of western Europe to the dancing of the fairies. They are now known to be occasioned by the growth of certain kinds of fungi, which, proceeding outward from a centre, render the soil for a time unfitted for the nourishment of grass, but later fertilize it by their decay.

Fairy Shrimp, a phyllopodous crustacean (*Chirocephalus diaphanus*), occasionally found in fresh-water ponds in Europe. It is about one inch in length, and nearly transparent.

Fairy-tales, stories in which fairies play a part, or which contain other supernatural or magical elements such as mark the folk-tales of ‹Puss in Boots›; ‹Beauty and the Beast›; ‹Hop o' My Thumb›; ‹Sleeping Beauty›; and others. Actual fairies seldom appear in traditional fairy-tales so called. Grimm and his successors showed by the study of comparative mythology that these tales are not restricted to Europe alone, but are to be found, in varying forms, among almost all nations. The survival of popular tales is due to their being unconscious growths, to the strict adherence to form shown by illiterate and savage people in recitals, and to the laws of the permanence of culture. There are several theories in regard to the origin of folk-tales. The oldest is the Oriental theory, which traces all back to a common origin in the Vedas. It is true that the germs of most tales are found in the Vedas, but proofs of the Indian origin of stories are lacking; the discovery of tales in Egypt which were written down in the period of the early empire are objections to its acceptance, and the idea of diffusion will not account for similar tales found in Australia, New Zealand, and America. The Aryan theory, supported by Max Müller, Grimm, and others, gives as their origin the explanation of natural phenomena. These nature-myths must not be regarded as originally metaphors; they were primitive man's philosophy of nature, in the days when every object was endowed with a personal life. The tales have enough likeness to show that they come from the same source, and enough difference to show they were not copied from each other. Müller says, «Nursery tales are generally the last things to be adopted by one nation from another." Another theory, supported by Tylor and Lang, traces the origin of folk-lore to a far earlier source than the Aryan,— the customs and practices of early man: such as totemism, descent from animals or things, which were at last worshipped; and curious taboos or prohibitions, which can be explained by similar savage customs of the present. But late authorities declare that it is useless to seek any common origin of folk-tales; since the incidents, which are few, and the persons, who are types, are based on ideas that might occur to uncivilized races anywhere.

Our popular fairy-tales, or *contes,* have been, in the main, handed down orally. However, some of their elements or variants at least have come down through ancient Oriental literature. The ‹Syntipas,› a Greek version, belongs to the 11th century. Then followed translations into several European languages. The earliest collection of European tales was made by Straparola, who published at Venice in 1550 his ‹Notti Piacevola,› which was translated into French, and was probably the origin of the ‹Contes des Fèes.› The best early collection is Basile's, the ‹Pentamerone,› published at Naples in 1637. In 1696 there appeared in the ‹Recueil› a magazine published by Moetjens at The Hague, the story ‹La Belle au Bois Dormant› (our ‹Sleeping Beauty›), by Charles Perrault; and in 1697 appeared seven others: ‹Little Red Riding Hood›; ‹Bluebeard›; ‹Puss in Boots›; ‹The Fairy); ‹Cinderella›; ‹Riquet of the Tuft›; and ‹Hop o' My Thumb.› These were published in 1697 under the title ‹Contes du Temps Passé Avec des Moralités,› by P. Darmancour, Perrault's son, for whom he wrote them down from a nurse's stories. Within this century the investigations of Jacob and William Grimm, and their successors in this field, have reduced to written form the tales of nearly all nations. We must include in the comparison of stories the Greek myths; as the Odyssey is now conceded to be a mass of popular tales. To these we must add the tales of ancient Egypt; those narrated by Herodotus, and other travelers and historians; the beautiful story of ‹Cupid and Psyche,› given by Apuleius in his ‹Metamorphoses› of the 2d century A.D., which also was taken from a popular myth. See Beauty and the Beast; Bluebeard; Cinderella; Elves; Fairy; Folk-lore, etc.

Faith, in Christian theology, a term used in conformity with its New Testament signification, to express ordinary belief or conviction, based upon reasonable evidence; also signifying confidence or trust in God, in Christ, and in the objects, seen or unseen, of religious regard. It likewise means the whole body of beliefs held by the Christian Church; hence, the Christian religion itself.

As understood by Roman Catholic divines, and as defined in the Catechism of the Council of Trent, faith is «that profound conviction of the mind by which we give firm and unhesitating assent to God when he reveals his mysterious truths»; or, in the words of John Henry Newman, it is «belief in certain doctrines because God has revealed them.» In the Roman Catholic system dogmas are a fundamental part of the Christian religion, no less essential than piety, love, and obedience: «Religion,» says Newman (‹Grammar of Assent,› chap. V.), «cannot maintain its ground without theology»; hence that «war-song of faith,» the Athanasian Creed, is to the Catholic believer «a psalm or hymn of praise, of confession, and of profound, self-prostrating homage, parallel to the canticles of the elect in the Apocalypse.» The Roman Catholic Church requires from all the faithful that they accept as of faith all the dogmatic canons of ecumenical councils and all the dogmatic definitions of Popes; but to accept these with «implicit» faith suffices. This faith is professed when one professes *ex animo* his belief in the one Holy Roman Catholic and Apostolic Church.

In the Protestant interpretation of faith, great emphasis is laid upon the willing surrender of the believer to the requirements of Christianity as understood by the various sects. The will itself is the chief organ of saving faith, through the action of which, in accepting the terms of salvation, the individual is brought into a state of forgiveness, justification (q.v.), and peace in his relations with God, with Christ, and with the spiritual world. The operations of the Holy Spirit are an incalculable factor with the individual, but can avail for salvation through the act of faith only with complete assent of his own will and all his being.

Faith-cure, the practice of curing or attempting to cure disease by appealing to the patient's faith, whether specifically religious in its nature or not; also any cure effected or supposed to have been effected by such means. (See Christian Science; Hypnotism; Suggestion; Therapeutics.) Questions concerning the legal status of practitioners of faith-cure under one or another name — sometimes «divine healing,» «faith-healing,» «mental science,» «prayer-cure,» etc. — have in recent years arisen in different States, but thus far no final determination of them has been reached. In view of present phases of these questions, in this and other countries, the following abstract of an opinion handed down 13 Oct. 1903 by the New York State Court of Appeals has a timely interest, especially as dealing with what many regard as a test case.

In 1901 a citizen of the State of New York, a member of the Christian Catholic Church, organized by John Alexander Dowie (q.v.), with which avoidance of drugs is a cardinal principle, was found guilty in a court of that State of violating the Penal Code by omitting to perform a duty imposed by the law — the furnishing of medical attendance for his sick child, who died of her illness. He was fined $500. The judgment was reversed by the Appellate Division, and the state appealed. In the opinion handed down by the Court of Appeals, affirming the verdict of the trial court, the main points presented are as follows:

> After the adoption of Christianity by Rome and the conversion of the greater part of Europe, there commenced a growth of legends of miracles connected with the lives of great men who became benefactors of humanity. The great majority of miracles recorded had reference to the healing of the sick through divine intervention, and so extensively was this belief rooted in the minds of the people that for 1,000 years or more it was considered dishonorable to practise physic or surgery. At the Lateran Council of the Church, held at the beginning of the 13th century, physicians were forbidden, under pain of expulsion from the Church, to undertake medical treatment without calling in a priest; and as late as 250 years thereafter Pope Pius V. renewed the command of Pope Innocent by enforcing the penalties. The curing by miracles, or by interposition of divine power, continued throughout Christian Europe during the entire period of the Middle Ages, and was the mode of treating sickness recognized by the Church. This power to heal was not confined to the Catholics alone, but was also in later years invoked by Protestants and by rulers.
>
> With the commencement of the 18th century a number of important discoveries were made in medicine and surgery, which effected a great change in public sentiment, and these have been followed by numerous discoveries of specifics in drugs and compounds. These discoveries have resulted in the establishment of schools and colleges throughout the civilized world for the special education of those who have chosen the practice of medicine for their profession. These schools and colleges have gone a long way in establishing medicine as a science, and as such it has come to be recognized in the law of our land. By the middle of the 18th century the custom of calling upon practitioners of medicine in case of serious illness had become quite general in England, France and Germany, and indeed, to a considerable extent throughout Europe and in this country. From that time the practice among the people of engaging physicians has continued to increase until it has come to be regarded as a duty devolving upon persons having the care of others to call upon medical assistance in case of serious illness.
>
> Formerly no license or certificate was required of a person who undertook the practice of medicine. A certificate or diploma of an incorporated medical college was looked upon by the public as furnishing the necessary qualification. The result was that many persons engaged in the practice of medicine who had acquired no scientific knowledge with reference to the character of diseases or of the ingredients of drugs that they administered, some of whom imposed upon the public by purchasing diplomas from fraudulent concerns and advertising them as real. This resulted in the adoption of several statutes upon the subject. The provision of the Penal Code [of New York State] under consideration was first adopted in 1881, following the statute of 1880 prohibiting the practice of medicine by other than a physician duly qualified in accordance with the provisions of the act. This, we think, is significant. The legislature first limits the right to practice medicine to those who have been licensed and registered, or have received a diploma from some incorporated college conferring upon them the degree of doctor of medicine; and then the following year it enacts the provision of the Penal Code under consideration, in which it requires the procurement of medical attendance under the circumstances to which we have called attention.
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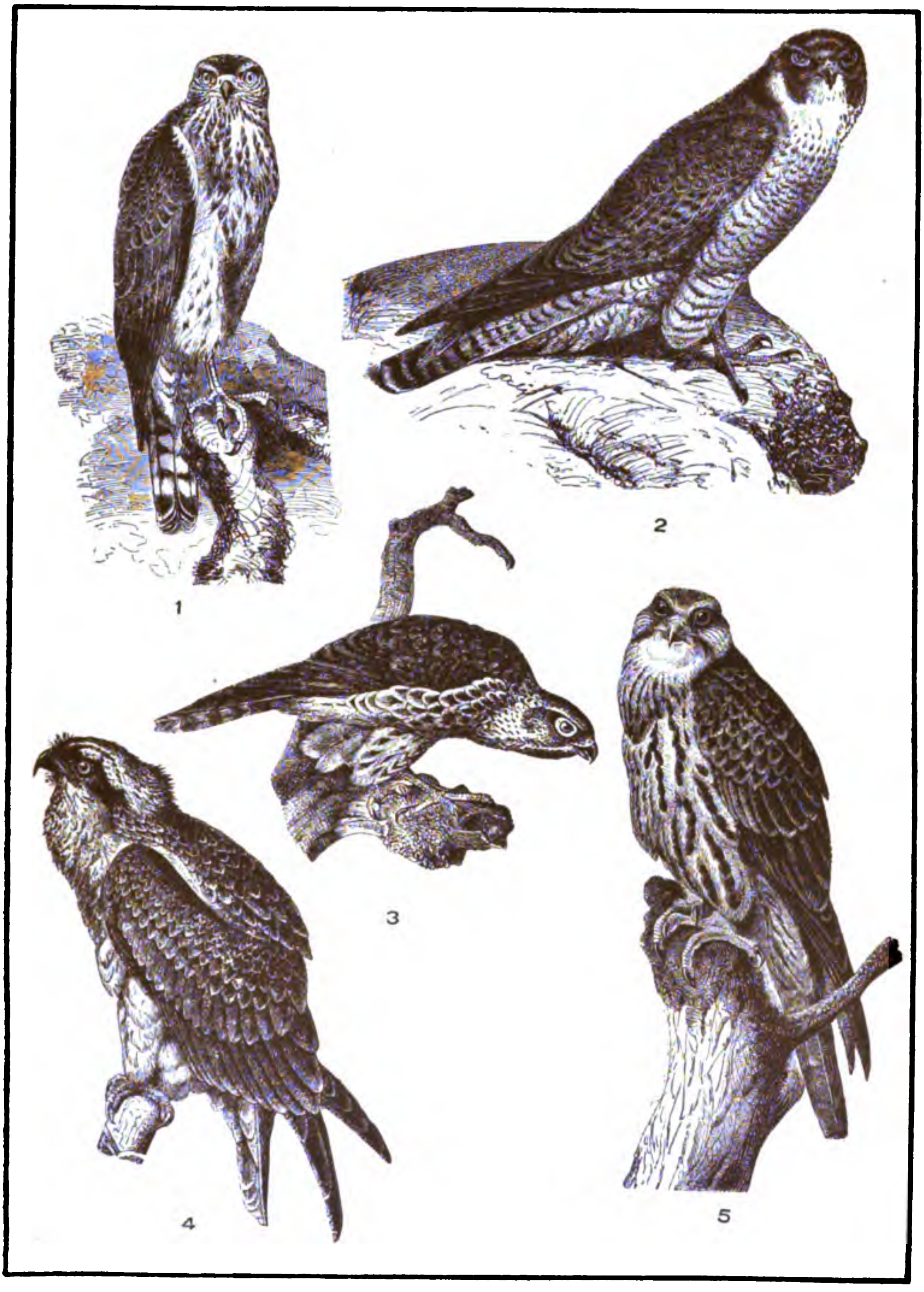
> We think, therefore, that the medical attendance required by the Code is the authorized medical attendance prescribed by the statute, and this view is strengthened from the fact that the third subdivision of this section of the Code requires nurses to report certain conditions

FALCONS.



1. Goshawk 2. Marsh Hawk. 3. Pigeon Hawk or Merlin.
4. Fish Hawk. 5. Saker Falcon.

of infants under two weeks of age "to a legally qualified practitioner of medicine of the city, town or place where such child is being cared for," thus particularly specifying the kind of practitioner recognized by the statute as a medical attendant.

The peace and safety of the State involves the protection of the lives and health of its children, as well as the obedience of its laws. Full and free enjoyment of religious profession and worship is guaranteed, but acts which are not worship are not. Children when born into the world are utterly helpless, having neither the power to care for, protect nor maintain themselves. They are exposed to all the ills to which flesh is heir, and require careful nursing, and at times when danger is present the help of an experienced physician. But the law of nature, as well as the common law, devolves upon the parents the duty of caring for their young in sickness and in health, and of doing whatever may be necessary for their care, maintenance and preservation, including medical attendance if necessary, and an omission to do this is a public wrong which the State, under its police powers, may prevent.

We are aware that there are people who believe that the divine power may be invoked to heal the sick, and that faith is all that is required. There are others who believe that the Creator has supplied the earth, nature's storehouse, with everything that man may want for his support and maintenance, including the restoration and preservation of his health, and that he is left to work out his own salvation, under fixed natural laws. There are still others who believe that Christianity and science go hand in hand, both proceeding from the Creator; that science is but the agent of the Almighty, through which he accomplishes results; and that both science and divine power may be invoked together to restore diseased and suffering humanity. But, sitting as a court of law for the purpose of construing and determining the meaning of statutes, we have nothing to do with these variances in religious beliefs, and have no power to determine which is correct.

We place no limitations upon the power of the mind over the body, the power of faith to dispel disease, or the power of the Supreme Being to heal the sick. We merely declare the law as given us by the legislature. We have considered the legal proposition raised by the record, and have found no error on the part of the trial court that called for a reversal.

Faithful Shepherdess, The, a pastoral drama by John Fletcher, published in 1609, and ranking with 'Comus,' which it partly inspired, as one of the finest specimens of this Italian form of poetry extant in English literature.

Faithfull, Emily, English philanthropist: b. Headley, Surrey, 1835; d. 31 May 1895. Out of pure philanthropy, she founded the Victoria *Press,* 1860, in which women alone were employed as operatives. Queen Victoria encouraged her by appointing her "publisher-in-ordinary to the queen." She started the 'Victoria Magazine' as an advocate of women's right to lucrative employment, and appeared in the United States as a lecturer in 1872–82. She was the author of 'Change Upon Change,' a novel (1868); 'Three Visits to America' (1884).

Falcon, a term broadly given to any of many birds of the family Falconidæ (q.v.), but more narrowly to the species of the typical subfamily Falconinæ, whence are derived most of the hawks used in falconry. The falcons proper for strength, symmetry and powers of flight, are the most perfectly developed of the feathered race. They are distinguished by having the beak hooked at the point, the upper mandible with a notch or tooth on its cutting edge. The wings are long and powerful, the second feather rather the longest; legs short and strong. The largest falcons are the three great arctic ones represented by the circumpolar jerfalcon (*Hierofalco, gyrfalco*), and its congeners the Greenland, Iceland and Labrador falcons (see JERFALCON). The type of its race, however, is the noble peregrine (*Falco peregrinus*), to the female of which the term "falcon" was alone given by falconers, and was most highly esteemed for the fierceness, dash and perfection with which she worked. The female is about 17 inches long and 3½ feet in extent of wing; the male is 2 or 3 inches less. The head, neck, a patch under the eye and the whole upper surface are dusky, with gray and brownish shades; the throat and under parts whitish or cream-colored, with dusky bars and arrowheads; legs and feet yellow, bill bluish. It chiefly inhabits wild districts, and preys on grouse, ducks, ptarmigans, pigeons, rabbits, seafowl, etc., pouncing upon them from above with terrific swiftness and force, and always betraying the greatest courage in its encounters with rivals or in defense of its nest, which is usually placed on a ledge of some lofty cliff. This species is to be found in nearly all quarters of the globe, for the North American duck-hawk (variety *anatum*) and certain tropical forms are only sub-species.

Other American true falcons are the pigeon-hawk, sparrow-hawk (qq.v.), and some closely allied western and northern forms. Many of the Old World falcons are famous, and are elsewhere individually described, such as the European hobby, kestrel, merlin, and lanner; the Asiatic shaheen, saker, luggur, turumti and other species trained by eastern falconers; the Australasian quail-hawk, and the large African genus Baza, which has the peculiarity of possessing two "teeth" on the edge of the beak. Another interesting genus is Microhierax, containing the finch-falcons (q.v.). Falcons attain to a great age. One is said to have been found in France, about 1790, with a collar of gold dated 1610, showing it to have belonged to James I. of England.

Falconer, fâk'nėr or fâ'kon-ėr, **Hugh,** Scottish botanist and palæontologist: b. Forres, Morayshire, 29 Feb. 1808; d. London 31 Jan. 1865. He was appointed assistant surgeon on the Bengal establishment of the East India Company. Arriving in India (1830) he examined and reported on a collection of fossil bones from Ava, and won scientific standing in India. In 1832 he was made superintendent of the botanic garden at Saharanpur. He discovered the geological character of the Sewalik Hills, and in order to study their ossiferous deposits he compared them with skeletons of extant species. For these researches he received the Wollaston medal of the Geological Society of England.

Falconer, William, English poet: b. Edinburgh, Scotland, 11 Feb. 1732; d. at sea off Mozambique 1769. Having early shipped before the mast, he became before 1750 second mate of a ship trading to the Levant. The experience of a shipwreck off Cape Colonna, Greece, furnished material for the poem of 'The Shipwreck' (1762), by which he is best known. He was later appointed purser of the frigate Aurora, royal navy, bound for India. The Aurora touched at the Cape of Good Hope in December 1869 and was shortly after lost with all hands. Falconer's 'Poetical Works,' with a biography by Gilfillan, appeared in 1854.

Falconet, Etienne Maurice, ā-tē en mō-rēs fāl-cō-nā, French sculptor: b. Vevay, Switzerland, 1716; d. Paris 4 Jan. 1791. Catharine II. of Russia patronized him, and he was employed by her to execute the colossal statue of Peter the Great, erected at Petersburg.

Falconidæ, a family of raptorial birds, comprising the sub-families *Gypaetinæ* (lammergeiers), *Polyborinæ* (carrion-hawks), *Accipitrinæ* (hawks), *Buteoninæ* (buzzards), *Aquillinæ* (eagles), and *Falconinæ* (falcons). They are all remarkable for strong and sharply hooked bills, with a distinct cere, usually fleshy; and most of them have sharp and powerful talons, designed to seize, kill, and tear to pieces the living prey upon which most of them subsist. In the eagles and falcons these characters are developed in the highest degree. The tarsus is usually more or less feathered, in some cases down to the very toes, which are arranged three in front and one behind, and are exceedingly strong and tenacious. There is a projection over the eyebrows except in the ospreys, which gives an appearance to the eyes of being very deeply set in the orbits. These birds range in size from the mighty lammergeier to the falconets, hardly bigger than sparrows. The female is usually decidedly larger than the male, and upon her falls the burden of the support of the young. The tribe is represented in all climates, even to the remote north, but is most numerous in the tropics, while some species are nearly cosmopolitan. Many migrate, but few show any tendency toward flocking. The color of the plumage frequently differs much in the young from that of the full-grown birds, and as their first plumage is retained for some time, this has caused more species to be enumerated than really exist. Plain tints rule, but white and black are often strikingly displayed, and a few species present a considerable variety of colors. Their voice is limited as a rule to screaming cries, but a few utter somewhat melodious notes. The nests of all are rude structures, placed in trees, on rock-cliffs, on the ground, or in some hole. The eggs are few in number — one to five as a rule — and are laid much earlier in the year than is the case with birds generally; and they and the young are well cared for and ably defended by the parents. The sport of falconry (q.v.) took its name from employing certain of these birds in the chase.

Falconio Diomede, apostolic delegate to the United States: b. Pescocostanzo, Italy, 20 Sept. 1842. He entered the Franciscan Order 2 Sept. 1860, and upon completing his studies came to the United States as a missionary, reaching Allegany, N. Y., December 1865, and being ordained priest by Bishop Timon of Buffalo, 4 Jan. 1866. In 1868 he was named president of the College and Seminary of Saint Bonaventure, Allegany, N. Y., and on 29 Nov. 1871, was sent by his superiors to Harbor-Grace, Newfoundland, at the request of the bishop of that diocese, who appointed Father Falconio his secretary and chancellor and rector of the cathedral. In 1882 he came back to the United States, where he remained a year. Returning to Italy in 1883, he was elected Provincial of the Franciscans in the Abruzzi, and in 1889 he was chosen procurator-general and later visitor-general in various provinces. He was preconized bishop of Lacedonia 11 July 1892, and on the 17th of that month was consecrated at Rome by Cardinal Monaco La Valletta. On 2 Feb. 1893, Mgr. Falconio assumed charge of his diocese. He was elevated to the United Archiepiscopal See of Accerenza and Matera in Basilicata, 29 Nov. 1895, but was called thence by Leo. XIII., 3 Aug. 1899, and appointed first apostolic delegate to Canada, taking possession at Quebec, 1 Oct. 1899. On 30 Sept. 1902, he was nominated apostolic delegate to the United States and assumed possession at Washington, D. C., 21 November of the same year.

Falconry, or Hawking, the employment of falcons in the chase. This sport is of Oriental origin, and has been practised in the East since before the days of any record,— in China at least 2,000 years before Christ; and it was probably followed at that date all over Asia and down into the Nile valley, for falconers with their hawks are depicted in some of the oldest Egyptian mural paintings. The sport spread over Europe with the Roman domination, but seems not to have been introduced into England until the 9th century. Many laws and social customs regulated this pursuit in Great Britain, and many terms and phrases remain in the language as an inheritance from the art and etiquette of this most elegant form of the chase. Thus the square frame on which hawks were carried to the field was named a «cadge,» and the servant who bore it a «cadger»; and a «cast» of hawks meant two taken on a chase together. To «man a hawk» was to tame it; and one so thoroughly trained as to be flown with young ones to show them how to work was called a «make hawk.» A hawk was said to «mew,» when molting; and to «plume» when she pulls off feathers. A female of any species, but especially of the peregrine, is a «falcon»; a male a «tiercel»; one caught wild a «haggard» or «passage hawk»; one reared from the nest an «eyas,» and a young one is a «red hawk»; while a falcon's nest is an «eyry.» All the actions of a hawk in its work are named. A hawk «stoops» when she descends upon the «quarry» (prey) with closed wings, to kill it by a stroke of the beak; she «binds» when she seizes large prey in the air and clings to it in its fall, or «trusses» when the prey is of small size. A hawk is said to «clutch» when (as do short-winged hawks) she seizes it in her feet; to «carry,» when she tries to fly away with the prey; to «check» when she flies at a bird other than the one intended for her; to «foot well» when she kills successfully; to «make her point» when she rises and hovers over some quarry which has escaped to cover, as in a thick hedge; to «ring» when she rises spirally in the air; to «take the air» when she tries to get above the fleeing quarry; to «wait on» when she hovers above her master at a certain «pitch» (height), waiting for quarry to be flushed. «Seeling» is closing the eyes with a fine thread (no longer done); «imping,» mending broken feathers; «mantling,» stretching out the wings or one wing and a leg; and «jarak» means keen, or in good condition for work.

The extensive agricultural changes which occurred in England during the 17th century, causing the enclosure and improvement of waste lands; the growth of towns and industry; the altered temper of the people preceding and during the Protectorate; and most of all the introduction of firearms, followed by the sports of shooting and the consequent preserving of game,— all tended toward the decline of falconry, both in England and on the Continent; and game-keepers and peasants began to shoot as «vermin» the grand and valuable birds upon which their forefathers had doted. Nevertheless the sport is still followed by fanciers who keep alive its traditions.

The hawks used in falconry are all true falcons, and nearly or quite the whole list have at some time or place been regularly trained, except in the United States, although here the best of material exists, in our duck-hawk (the peregrine), pigeon, and sparrow-hawks, southwestern prairie-falcon and others. A few clubs here and there have flown their hawks, but the sport shows little sign of becoming general in North America. It is more frequent in Central and South America. In North Africa and the Orient the sport flourishes as much as formerly; and there eagles are often employed, and quarry as large as gazelles and bustards is struck down.

Falconers divide their birds into «long-winged» or «dark-eyed» hawks, and «short-winged» or «yellow-eyed» hawks. The first class contains the true falcons, of which the great jerfalcon (q.v.) was in old times reserved for royalty, the peregrine for an earl, and the others for the nobility; hence these were known as «noble,» while the goshawk, kestrel, etc., on account of the inferiority of their masters as well as of their own powers, were styled «ignoble.»

Hawks are taken for training either as nestlings or when full-grown. They are trained by being hooded, made to wear bands of leather («jesses») about the legs, to which are attached «varvels» (rings, sometimes carrying bells hung by «bewits»), and a swiveled «leash»; and gradually are accustomed, at first in complete darkness, to being fed and handled, and later to feeding in the light and among spectators, and finally to take first live birds thrown toward it and finally wild quarry. During this process young birds are much at liberty and are then said to be «flying at hack.»

The sport was one in which women as well as men of all classes might indulge, going afield on foot and alone, or in mounted cavalcades, and often during mediæval times with royal pomp. The hawks, hooded, were carried by servants on frames suspended from their shoulders, but each sportsman was likely to hold a favorite bird upon his gauntleted wrist — in Europe on the left wrist, in the Orient on the right. Dogs, especially small greyhounds and pointers, were likely to accompany the falconer and were put to use in flushing birds, starting hares and the like. When the hunting scene was reached the hawks were prepared for flight, and some were freed to «wait on» until quarry was sighted; but others, trained differently, were kept hooded until the falconer himself started or perceived the game, when they were unhooded and sent after it. The sportsmen then followed, watched the chase, and recovered prey and hawk as well as they could. Good falcons show a keen interest and great intelligence in their work.

Many books describe both the sport and the falcons in great detail. One of the best of the early works is 'The Booke of Faulconrie or Hawking,' by Turberville (1575). Recent British authors of repute are Brodrick, Salvin, Freeman ('Practical Falconry,' 1869), and J. E. Harting ('Hints on the Management of Hawks,' 1884). The latest general work is 'Coursing and Falconry,' by Cox & Lascelles, in the Badminton Library, 1892.

Faldstool, or Foldstool, the name of various pieces of English church furniture, the principal being a portable folding seat, also called faldistory, similar to a camp-stool used by a bishop when officiating in other than his own cathedral church; and a small desk at which the litany is read, the name dating from a period when folding lecterns were used.

Falerii. See FALISCI.

Falernian Wine, one of the favorite wines of the Romans, so called from *Falernus Ager* (the Falernian Field), the district in which it was grown, in Campania, Italy. It is described by Horace as, in his time, surpassing all other wines then in repute. In the time of Pliny, however, as he himself informs us, Falernian wine had already, owing to a want of care in its cultivation, begun to decline in quality. See WINE.

Falguière, Jean Alexandre Joseph, zhŏṅ ä-lex-zäṅdr fäl-gyăr, French sculptor and figure painter: b. Toulouse, France, 7 Sept. 1831. Both in sculpture and painting his work is of very notable excellence, and displays originality and vigor. The Luxembourg Gallery in Paris contains his sculptures: 'Christian Martyr' (1868); and 'Victor in the Cock Fight' (1870). Among his most noted paintings are: 'The Wrestlers' (1874); 'Susanna'; and 'Slaughter of a Bull' (1881).

Falieri, Marino, mä-rē'nō fä-lē-ä'rē, Doge of Venice: b. 1278; d. Venice 17 April 1355. He commanded the troops of the republic at the siege of Zara in Dalmatia. He there gained a brilliant victory over the king of Hungary, and was afterward ambassador to Genoa and Rome. He was elected doge of Venice on 11 Sept. 1354, but in the following year dissatisfaction with the light punishment imposed upon a noble who had insulted Falieri's young wife caused him to conspire with the lower orders to overthrow the republic and make himself sovereign of the state. His plot was discovered on the night before it was to have been consummated, and he was beheaded 17 April 1355. The last scenes of his life are depicted in Byron's tragedy of 'Marino Falieri.' Plays have been written on the same subject by Casimir Delavigne and Swinburne.

Falisci, fȧ-lis'ī, a people of Etruria, said to have been originally a Macedonian colony. They occupied Falerii, one of the 12 Etruscan cities. When they were besieged by the Roman general Camillus, a schoolmaster offered to betray his pupils into the hands of the enemy, that, by such a possession, he might easily oblige the place to surrender. Camillus heard the proposal with indignation, and ordered the man whipped back to the town by the very pupils whom his perfidy would have betrayed. This instance of magnanimity operated upon the people so powerfully that they surrendered to the Romans.

Falk, Paul Ludwig Adalbert, powl lood'-vĭH ä'däl-bĕrt fălk, Prussian statesman: b. Metschkau, Silesia, 10 Aug. 1827; d. 7 July 1900. He was appointed minister of public worship and education in 1872, and in this capacity was mainly instrumental in carrying the so-called May laws (because passed in May 1873-4-5), aimed at the restriction of the Roman Catholic

Church in Germany, by limiting the influence of the clergy in the schools, by reorganizing the seminaries for the training of teachers, and by defining in a stricter and more comprehensive manner the relations generally of the clergy to the state. When, however, Bismarck came to bid for the support of the clerical party, in order to carry out his later internal policy, Falk was compelled to resign.

Falk, fälk, **Johannes Daniel,** German author: b. Dantzic, Prussia, 28 Oct. 1768; d. 14 Feb. 1826. His capacity for satire was considerable. Among his works are: ‘A Pocket Book for Friends of Jest and Satire’ (1797); ‘Men and Heroes’ (1796), a satire in verse, and ‘Prometheus’ (1804), a dramatic poem.

Falke, Jacob von, yä'cōp fon fäl'kĕ, German connoisseur and historian of taste: b. Ratzeburg 21 June 1825. His administrative capacity has placed many art galleries and repositories of art treasures in Germany and Austria upon a successful basis. His writings, particularly ‘Knightly Society in the Days of Homage to Womanhood’ (1862); ‘History of Modern Taste’ (1866); ‘Art and Art Study’ (1878); ‘Hellas and Rome’ (1879); and ‘History of Taste in the Middle Ages’ (1893), are notable for both learning and judgment.

Falkirk, fâl'kėrk, **Battle of,** a contest in which Edward I. of England gained a victory over Wallace 22 July 1298. The king's army is said to have contained 7,000 to 8,000 mounted men and 80,000 footmen. Wallace's force amounted to about a third of the English army. His infantry was drawn up in circles, the men in the outer ring kneeling and holding their lances obliquely. The archers occupied the centre of the circles. The overwhelming superiority of the enemy's horse, however, decided the battle. Wallace retired with a small body to Stirling, but the bulk of his army was broken up and destroyed. See WALLACE, SIR WILLIAM.

Falkland, fâk'lạnd, **Lucius Cary,** VISCOUNT, English statesman and soldier: b. probably at Burford, Oxfordshire, 1610; d. Newbury 20 Sept. 1643. In 1633 he succeeded his father in the peerage, and for some years after chiefly resided at his seat of Burford, which he made a kind of academy of learned men, being continually surrounded by the scholars from the neighboring universities, and visitors from London. Here it was that Chillingworth composed his famous work against “Popery”; and questions of morals, theology, and literature were discussed in a congenial circle with the utmost freedom. In 1640 he was chosen member of the House of Commons for Newport, Isle of Wight. At first he warmly supported the Parliament party, but a strong attachment, however, to established forms, and some doubts of the ultimate objects of the parliamentary leaders, caused him to retract, and he embraced the party of the king when hostilities commenced, and attended him at the battle of Edgehill and the siege of Gloucester. At the battle of Newbury he was struck from his horse by a musket-shot, and was found the next day dead upon the field.

Falkland Isles, two large islands, with a number of smaller ones surrounding them, in the South Atlantic Ocean; about 300 miles east of the Strait of Magellan. Area, 7,510 square miles. The soil is light, and but scanty crops are obtained. Sheep raising is the principal occupation. The capital is Stanley. These islands were discovered by Davis in 1592, and came into the possession of the British in 1771. Their appropriation has been at times disputed; but since 1833 the British have held uninterrupted occupancy of them.

Falkner, fäk'nėr, **Roland Post,** American statistician: b. Bridgeport, Conn., 14 April 1866. He was graduated at the University of Pennsylvania in 1885; studied economics at Berlin, Leipsic, and Halle-on-Saale, Germany; was instructor in accounting and statistics in the University of Pennsylvania in 1888–91, and professor of statistics in 1891–1900. He served also as statistician of the United States Senate Committee of Finance in 1891; as secretary of the United States delegation to the International Monetary Conference; and as secretary of the conference in 1892. He is author of numerous essays on criminology, sociology, etc.; chief of the division of documents in the Library of Congress, and editor of ‘Annals’ of the American Academy of Political and Social Science.

Fall Army Worm, the caterpillar of a gregarious moth (*Laphygma frugiperda*). See GRASS-WORM.

Fall-fish, or **Silver Chub,** a cyprinodont fish, or “minnow” (*Semnotilus corporalis*) of the eastern United States. It is very common east of the Alleghanies in clear, swift streams and rocky pools, and reaches 18 inches in length. It is steel blue above, sides and belly silvery, but in the breeding season the fins and lower surface of the males are rosy. The fins are of moderate size and unspotted.

Fall of Man, a commonly received doctrine of Christianity, founded upon the historical narrative contained in the third chapter of the book of Genesis, together with the allusions to the same matter in other parts of Scripture. The history of the fall, as given in Genesis, contains the following particulars: God having placed Adam and Eve in the garden of Eden, and forbidden them under pain of death to eat of the fruit of the tree of the knowledge of good and evil, Eve, tempted by the serpent, first ate of the fruit herself, and afterward gave of it to her husband, who followed her example. Both were driven out of Eden. Punitive sentences were passed upon each of them, and upon the serpent, which is alluded to by St. Paul as representing the devil. In the subsequent narrative the consequences of the fall significantly appear. The first man born of the original pair is a murderer, and his descendants grow in wickedness until a flood is sent to carry them away. As might be expected, this most suggestive narrative has given rise to inexhaustible controversy. The opinions on the fall may be divided into three classes: those which reject the narrative altogether; those which accept it as a mythical or allegorical account of the origin of evil; those which regard it as in the main historical. As a mere matter of literary criticism, the uninterrupted flow of the narrative down to times and events evidently historical, together with the uniformity and sobriety of its style, leave little ground for the supposition that the writer himself supposed he was dealing in allegory. The historical view of the fall, besides the theoretical controversies to which it gives rise as to its account of the origin of evil, encounters difficulties from two sources — the modern sciences of chronology and ethnology. In the meantime these remain difficulties only, as these sciences are by no means in a state of sufficient maturity to allow their conclusions to be absolutely applied. It is remarkable that in most mythologies the serpent is worshipped as a beneficent being, though Tylor shows that Aji Dahaka of the Zarathustrians (Zoroastrians), which is a personification of evil, may have an historical connection with the serpent of Eden. With regard to the relation of man's fall to that of Adam, St. Paul says «by one man's disobedience many were made sinners» (Rom. v. 19), and «as by one man sin entered into the world, and death by sin, and so death passed upon all men for that all have sinned» (ver. 12). It seems impossible to reconcile the constant appeals made in Scripture to the moral nature of man with the notion that that nature is inherently and radically corrupt. It would also appear that the statements of Scripture with regard to the actual moral condition of man, strong as they are, do not absolutely require this mode of accounting for them. Without supposing any radical change of man's moral nature, or even any change of it whatsoever, it is only necessary to suppose a change in his relation to God to explain all that is said regarding him. It is supposed that man's moral nature consists of capabilities which are good or bad according as they are directed, and that God himself is the object of all its highest aspirations. The fall being supposed to consist in the alienation of man from God, it is easy to perceive that all these aspirations, being deprived of their proper objects, must apply themselves to improper ones, and become evil in their tendency; hence the sudden rise of pride, selfishness, ambition, and all evil passions. In as far also as man's nature is affected by the hereditary transmission of qualities it might become actually vitiated in its tendencies, and this, together with the accumulation of evil habits, would produce those climaxes of violence or corruption which have from time to time convulsed or disintegrated society, which have called forth the denunciations of prophets, and by their very excesses have produced a reaction, which, however, has left human nature as incompetent to guide itself as ever, and ready, after a period of repose, to progress toward another crisis. The fall, according to this view, consists in the moral inadequacy of man's nature when left to itself, and the actual evils flowing from this inadequacy. It is argued by theologians that in the original sentence pronounced on the transgressors there is contained the promise of a redemption, and they maintain that the whole scope of Scripture is directed to the development of this promise, and of the scheme of providence associated with it. It is from the New Testament, however, and not from the Old, that the whole doctrine of the fall has been built up. Milton seized on this as the groundwork of his two great poems. See ADAM; ORIGINAL SIN.

Fall Poison, the name given in the United States to the plant *Amianthium muscætoxicum*, so called because cattle feeding on its foliage in the fall of the year are poisoned.

Fall River, Mass., city, port of entry, in Bristol County; on Mount Hope Bay at the mouth of the Taunton River; on the New York, N. H. & H. R.R.; 49 miles south of Boston. It is connected with New York by the Fall River line of steamers, with Philadelphia by the Windsor freight line, and with New England seaports by passenger and freight lines of steamers. The area of the city is 41 square miles, and it is 200 feet above sea-level. It has a good harbor, sufficiently commodious for the largest steamers, and excellent water power, as the Fall River, the outlet of Watuppa Lake, has a fall of 129 feet in less than half a mile. The water for city uses comes from Lake Watuppa, and the waterworks plant is owned by the municipality. The streets are well laid out; many of the buildings are constructed of the granite which is found in the vicinity. It has excellent public and parish schools, notably the B. M. C. Durfee public high school and the Academy La Ste. Union des Sacrés Cœurs; good circulating libraries, a State armory, over half a hundred churches and chapels, daily and weekly newspapers, and electric street railway connections with neighboring cities and towns.

Fall River is the largest cotton-milling city in the United States. According to the Federal census of 1910 the city had 288 manufacturing establishments, employing $82,086,000 capital, and 37,139 persons; paying $16,853,000 for wages, and $35,524,000 for materials; and having a combined output valued at $64,146,000. The cotton industry, 42 establishments, with $46,000,000 capital, and a combined output valued at $30,000,000. Next in value of output was the dyeing and finishing of textiles ($3,000,000). Other important manufactures were foundry and machine shop products ($1,000,000); bakery products ($600,000). The city has a number of national banks, with a capital of about $2,500,000, and several savings and co-operative banks. The exchanges at the United States clearing-house during the year ending 30 Sept. 1910, aggregated $61,031,300.

The city was originally a part of Freetown, but was incorporated separately in 1803. Later it was called Troy, but its first name was restored in 1834. The city charter was granted in 1854, and in 1862 Fall River in Newport County, R. I., was annexed. Pop. (1910) 119,295. JOHN H. ABBOTT.

Fall Trank, a drink once reputed to cure the effects of falls; a vulnerary made from several aromatic and slightly astringent plants which grow chiefly on the Swiss Alps; hence the name *Vulneraire Suisse*, given to such dried plants cut into fragments. Within the 19th century, in England, a kind of vulnerary known as black beer was often prescribed in country practice for inward bruises.

Fall Webworm. See WEBWORM.

Fallacy, in logic, an argument used as decisive of a particular issue, which in reality it does not decide. Fallacies are variously classified by different logicians. A fallacy may either exist in the substance or in the form of the argument. If it exists in the substance it does not belong to logic, as commonly understood, to expose it; but logicians differ as to what constitutes the proper distinction between form and substance. J. S. Mill in particular extends the sphere of logic in respect to the treatment of fallacies beyond what has been usually assigned to it.

Fallen Timbers, Battle of, 20 Aug. 1794; on the Maumee River, about 15 miles from Toledo, Ohio. The Indians had about 2,000 warriors, with 70 white rangers, French, English, and renegade Americans; they were in a line some two miles long at right angles to the river, behind a forest blown down by a hurricane. Wayne had some 3,000 men; 2,000 regulars, and 1,000 mounted volunteers from Kentucky, under Charles Scott, who were thrown to the left to turn the Indians' flank. The Indians began the attack and drove in the advance volunteers; then Wayne sent his regular cavalry to repel them, while his first line of infantry advanced with trailed arms, firing at close range and then charging with the bayonet. Both attacks were entirely successful. Less than 1,000 of the Americans were engaged. They chased the Indians up to the British fort some miles away. Their total loss was 33 killed and 100 wounded, the Indians and British probably losing two or three times as many killed. Eight Wyandot chiefs were slain. This defeat, the greatest ever suffered by the northwestern Indians, led to the treaty of Greeneville (q.v.).

Fallet, Nicholas, French author: b. Langres in the department of Haute-Marne, France, 1753; d. Paris 22 Dec. 1801. He was the son of a hatter, and was destined for the bar; but irresistibly drawn toward literature he removed to Paris, where he became a contributor to the 'Gazette de France,' the 'Journal de Paris,' and the 'Dictionnaire Universel.' Chief among his works are the tragedies 'Barnevelt' (1775) and 'Tibère' (1783); the comic opera 'Matthieu' (1783), 'Les Fausses Nouvelles,' a comedy, and two collections of poems, 'Mes Prémices' (1773), and 'Mes Bagatelles' (1776).

Fallières, Clément Armand, French politician and statesman: b. Mézin, in the Department of Lot-et-Garonne, 6 Nov. 1841. He studied law, was admitted to the Bar of Nérac, and from 1871–5 was mayor of that city. In 1876, 1877, and 1878 he was elected as a Republican to the Chamber of Deputies, in the latter year being appointed Minister of the Interior, a position which he again occupied in 1882 and 1883. From 1883–5 and again from 1889–90 he was Minister of Public Instruction; in 1887 Minister of the Interior; and in 1887–8 and again from 1890–2 Minister of Justice. In 1890 he was elected Senator, a position which he has held ever since. In 1899, when Loubet became President of the Republic, Fallières succeeded him as President of the Senate, a post to which he was elected in 1900 and on 11 Jan. 1906. On 17 Jan. 1906 the National Assembly elected him President of the Republic to succeed Loubet (q.v.).

Falling Bodies. See ACCELERATION; FORCE; FORCE OF GRAVITY; GRAVITATION; GRAVITY; MECHANICS; etc.

Falling-sickness. See EPILEPSY.

Falling Stars. See METEORS.

Fallmerayer, Jacob Philipp, yä'kōp fē'lip fäl'mē-rī-ėr, German author: b. Tschötsch, Austrian Tyrol, 10 Dec. 1790; d. Munich 26 April 1861. As a scholar, especially linguist, and as an explorer of the Orient, his fame is international and his work authoritative. He published: 'Fragments from the Orient' (1845); 'History of the Peninsula of Morea in the Middle Ages' (1830), and other important writings.

Fallopian Tubes, two ducts or canals about five inches long and one third of an inch in diameter, attached to the upper corners of the uterus. Within they are lined by a mucous membrane continuous with that of the uterine cavity, but differing in having cilia. Outside of the mucous membrane there is a thin layer of muscle-tissue. The outermost layer is from the peritoneum, in large part a fold of the "broad ligament." At the free end the tube flares out into fimbriæ, thus exposing a large surface to catch the ova given off from the surface of the adjacent ovary. Aided by the waving cilia, an ovum passes down this tube to the uterine cavity, there to undergo development or to be extruded with menstrual blood. Spermatozoa can pass up the Fallopian tubes and impregnate an ovum within the lumen. Development then becomes possible, giving rise to tubal pregnancy or ectopic gestation.

Fallopio, Gabriele, gä-brē-ā'lĕ fāl-lop'pē-ō (usually known as FALLOPIUS), Italian anatomist: b. Modena 1523; d. 9 Oct. 1562. He studied at Ferrara and at Padua, at which last place he is said to have attended the lectures of Vesalius. He became professor at Ferrara, whence, in 1548, he removed to Pisa. He continued there three years, and was then made professor of surgery, anatomy, and the materia medica at Padua, where he remained till his death. The principal work of Fallopius is his 'Observationes Anatomicæ' (1561, 8vo), which, as well as his other writings, has been several times reprinted. He was the first anatomist who accurately described the vessels and bones of the fœtus; and his account of the Fallopian tubes in females has perpetuated his name.

Falloux, Alfred Frédéric Pierre, āl-fred frā-dā-rik pē ār fä-loo, French writer: b. Angers, France, 7 May 1811; d. there 7 Jan. 1886. Legitimist and clerical sympathies influenced his career, his typical writings being: 'Madame Swetchine, her Life and Works' (15th ed. 1884); 'Story of Louis XVI.' (6th ed. 1881); and 'Political Speeches and Miscellany' (1882).

Fallow, land which, after being tilled, is left for a season or more without being planted or sown. The Roman system of wheat raising was a rotation of fallow and wheat alternately. Under the Romans Britain exported a great quantity of wheat, and for centuries afterward the same system was followed. The method presupposed a moderately fertile soil, and turned out best where clay was present. The object of fallowing is to liberate fertilizing elements from the mold, admitting air and destroying noxious plants and insects. Improvements in agricultural methods and the multiplication of fertilizing material has caused the abandonment of this resort to fallowing which, however, might in some cases be revived with advantage. For summer fallow the land should be ploughed at the end of May; for winter fallow the land should be ploughed in autumn.

Fallow crops is a term applied to green

manuring crops (see Green Manuring), which are of more advantage in moist than in dry climates, where injury is likely to be wrought by autumnal draughts. Bastard fallowing is the Scotch practice of ploughing hay-stubble at the end of summer. It is known in North America as short fallow and is very beneficial.

Fallow-deer, a dun-colored deer (*Dama platyceros*) native in southern Europe, and eastward. It is smaller than the red deer, has palmated antlers, and soft, fine fur. Its color is yellow-brown in summer, shading to white on the ventral surfaces, and its winter coat is darker. It is usually spotted, especially when a fawn. The male is called a buck, the female a doe, the young a fawn. The doe is without horns. The deer is smaller than the stag and has more spreading horns. It goes in herds and each herd has its master, an old buck, which all the others obey. This is a woodland deer, whose flesh supplies one of the choicest varieties of venison. Though native only southward the fallow-deer has been introduced into the parks and game-preserves of northern Europe, whence it has in some instances escaped and returned to a wild state. It has multiplied and flourished, especially in England.

Fallows, Samuel, American Reformed Episcopal bishop: b. Pendleton, Lancashire England, 13 Dec. 1835. He came to America in 1848; was graduated at the University of Wisconsin in 1859; was minister in the Methodist Episcopal Church 1859–75, and later of the Reformed Episcopal Church. He served with distinction in the Civil War; was State superintendent of public instruction in Wisconsin 1871–4; regent of the University of Wisconsin in 1866–74; and president of Wesleyan University in 1874–5. He became rector of St. Paul's Reformed Episcopal Church in Chicago in 1875, and bishop in 1876. He is author of numerous works, including: 'Handbook of Abbreviations and Contractions'; 'Life of Samuel Adams'; 'Students' Biblical Dictionary'; 'Past Noon'; 'Splendid Deeds'; 'Supplemental Dictionary of the English Language,' etc.

Falls City, Neb., city, county-seat of Richardson County; on the Burlington & M., and the M. P. R.R.'s; about 85 miles southeast of Lincoln. Its chief manufactures are flour, canned goods, cigars, foundry products, furniture, and beer. The trade is chiefly in wheat, corn, cattle, and manufactured articles. The electric light and waterworks plants are owned by the city. It has a good public library. Pop. 3,500.

Falmouth, fal'muth, England, a seaport town in the county of Cornwall, at the mouth of the Fal River, 11 miles from Truro. It has a good harbor, and a fine and spacious roadstead. There are two castles on the coast, one of which, Pendennis, commands the entrance of the harbor; and the other, on the opposite side, is St. Mawes Castle. Its trade consists chiefly in tin, copper, firearms and ammunition, and chemical products. Pop. 11,825.

Falmouth, Ky., city, county-seat of Pendleton County; 32 miles southeast of Cincinnati; on the Licking River, the Louisville & N. R.R. It is in an agricultural region, and its manufactures are woolen goods, flour, lumber, dairy products, and canned goods. Live stock and tobacco are shipped to Covington and Newport on the Ohio River. Pop. (1910) 1,180.

Falmouth, Mass., town in Barnstable County; on Buzzard's Bay, Vineyard Sound, and on the New York, N. H. & H. R.R., at the extreme west end of Cape Cod; 50 miles northwest of Boston. It is the centre of an agricultural and cranberry region. It is best known as containing the Wood's Holl (q.v.) Station of the United States Fish Commission. Pop. (1910) 3,144.

False Bay, an inlet on the coast of Cape Colony, South Africa; circular in form, about 24 miles long, and so well protected from storms as to make it a good shelter harbor. It is a British naval station.

False Cadence, a musical term. When the last chord of a phrase is other than the tonic chord, and is preceded by that of the dominant, the cadence is said to be interrupted, false or deceptive. See Cadence.

False Chinch-bug. See Wheat Insect Pests.

False Decretals. See Decretals, False or Pseudo-Isidorian.

False Demetrius, The. See Demetrius.

False Imprisonment, the unlawful detention of a person, whether in a common prison or a private house, or even by forcibly detaining one in the streets or highways. The law punishes false imprisonment as a crime, besides giving reparation to the party injured, through an action in tort.

False Indigo, a common name for some American species of the genus *Amorpha*, of the pea family. The most widely known plant called by this name is *A. fruticosa*, a shrub growing from 5 to 20 feet in height, along streams in Ohio, Minnesota and Manitoba, south to Florida, Colorado and Mexico. When found in the Middle States, it is an escape from cultivation, its spike of purple flowers making an exceedingly ornamental shrub.

False Personation, for the purpose of obtaining property of others, was formerly a misdemeanor punishable by a fine or imprisonment, but is now made penal by special statute. The penalties for personation are frequently heavy. Thus to personate the owner of any share, stock, or annuity, etc., is felony, and liable to a term of imprisonment. The false personation of voters at an election is a misdemeanor punishable with imprisonment.

False Point, a cape and harbor of Bengal, 43 miles east of Cuttack. The harbor, with its large lighthouse on the cape, is safe and capacious, and is considered the best between Calcutta and Bombay; it is the entrepôt for the trade of Orissa, and a regular port of call for the British Indian Company's steamers. The name was given because frequently this projection was mistaken for Point Palmyras.

False Pretenses, for the purpose of obtaining property is a misdemeanor at common law, and punishable by fine or imprisonment. Some kinds of it are now punishable by imprisonment not exceeding five years, the statutes, however, varying in different States.

False Scorpion, or **Book Scorpion,** a diminutive spider-like creature of the order

Pseudoscorpionida (see ARACHNIDA), allied to the "harvestmen" and "false spiders." They occur in all the warmer parts of the world, under bark, stones and rubbish, or hidden in deep moss; and one typical species, the "book scorpion" (*Chelifer cancroides*), infests museums, old libraries, and dusty corners generally. Unlike the spiders these have no constricted "waist" separating the abdomen from the foreparts; and like the true scorpions the pedipalps are developed into relatively enormous chelate arms. The book scorpion thus resembles a minute crab. They are slow in their motions, feeling their way along with their pincers; and several blind species inhabit caverns. They have spinning glands, situated in the cephalothorax, but use the silk only for making small protective cells or cases into which they retreat when laying eggs (afterward carried about by the female), or molting, or during hibernation.

False Spider. See SCORPION SPIDER.

False Weights and Measures. See WEIGHTS AND MEASURES.

Falsetto (Ital.), in singing, a term applied to the notes above the natural compass of the voice. It is also called a head or throat voice, in contradistinction to the chest voice, which is the natural one. The falsetto voice is produced by tightening the ligaments of the glottis. Its thin, constrained effect is most noticeable in men with deep-set voices, the register of which it frequently extends more than an octave above the pure chest voice.

Falstaff, fâl'staf, **SIR John,** a character in Shakespeare's dramas, 'Henry IV.,' Parts I. and II.; 'Henry V.,' and 'Merry Wives of Windsor,' conspicuous for lying, cowardice, drunkenness, and boastfulness, yet brimming over with wit and geniality. See FASTOLF, SIR JOHN.

Falster, fäl'stĕr, **Christian,** Danish poet: **b.** 1 Jan. 1690; d. 24 Oct. 1752. His 'Satires' on his age, modeled on Juvenal, gave him eminent rank among the native poets. He wrote three volumes of 'Philological Amenities or Various Discourses,' containing a mass of highly interesting observations on the affairs of the time.

Falster, one of the Danish islands in the Baltic, separated by narrow straits from Zealand on the north, Moen on the northeast, and Laaland on the west; area, 18 square miles. It is well watered, richly wooded, and so prolific in fruit that it has been called the "Orchard of Denmark." The chief products are corn, hemp, hops, cattle, honey, and wax. Some shipbuilding is carried on. The capital is Nykjöbing. Pop. about 35,000.

Falun, or Fahlun, fä'loon, **Sweden, town,** capital of the county (län) of Kopparberg; on a stream connecting lakes Varp and Runn; 130 miles northwest of Stockholm. What is now included in the town of Falun was once nine little villages. Many of the buildings date from the 14th century; one, an old church, has a green copper roof. It is the seat of a mining school, and it contains a hospital, gymnasium, and several other public buildings of note. The town owes its prosperity to the copper mines in the vicinity, which have been called the richest in the world. Gold and silver are also mined, but the rich "copper mines of Falun" have given to the town the name of "The Treasury of Sweden."

Consult: Nordenström, 'L'Industrie Minière de la Suède' (1897); Sundbarg, 'La Suède, son Peuple et son Industrie.'

Faluns, fä-lun, a French provincial term for the shelly Tertiary (Upper Miocene) strata of Touraine and the Loire. Though generally composed of shelly sand and marl, in some districts they form a soft building stone, chiefly composed of an aggregate of broken shells, bryozoa, corals, and echinoderms, united by a calcareous cement. They are found in scattered patches of wide extent, but rarely more than 50 feet in thickness; they have long been known and utilized for their fertilizing properties. The fossils are chiefly marine, but there occur also land and fresh-water shells, and the remains of numerous mammals.

Fama, fā'ma, in mythology, the Roman goddess of fame, rumor, reports, news, or tidings of any sort, whether good or evil. A graphic description of this goddess is found in Virgil, who represents her as winged and with as many ears, eyes, and tongues as feathers. She is sometimes pictured with a trumpet, either blowing it or holding it in her hand.

Famagosta, fā-mä-gos'tä, or **Famagusta,** fā-mä-goos'tä (ancient ARSINOE), a seaport on the Island of Cyprus, 40 miles east of Nicosia. Famagosta, during the Venetian régime, was one of the richest and most populous towns in the Levant. The name, Fama Augusta, shows its Roman origin. It is now almost in ruins, with its once fine harbor nearly choked with sand, having declined since its conquest by the Turks in 1571. About five miles northeast are the ruins of Constantia, occupying the site of the ancient Salamis, now called Eski, or Old Famagosta. Guy de Lusignan was here crowned king of Cyprus in 1191. Since Great Britain obtained control of Cyprus, Famagosta has begun to revive in importance. Pop. (1901) 3,825. (See CYPRUS.) Consult: Fyler, 'Development of Cyprus, and Rambles on the Island'; Cesnola, 'Cyprus; its Ancient Cities.'

Familiar Spirit, one of those demons or evil spirits which were supposed to attend and be at the service of a magician or other favored person. The belief in familiar spirits is very ancient, and by the law of Moses such as had familiar spirits were to be put to death. Where Socrates speaks of his attendant demon, he is generally understood to refer to the inner feelings and promptings of his nature, and not to any familiar spirit. In Eastern countries the belief in familiar spirits is very general. Attendant genii in Oriental tales are represented as sometimes good and sometimes evil. The "slave of the lamp" mentioned in the 'Arabian Nights' is a well-known illustration of this superstition. A belief in familiars was widely diffused over Europe in the Middle Ages. Jovius says that Cornelius Agrippa was always accompanied by a devil in the form of a black dog; and Goethe makes Mephistopheles first appear to Faust in this shape. Paracelsus was believed to carry about with him a familiar spirit in the hilt of his sword. See WITCHCRAFT.

Familists, name of a sect which arose in Holland about the middle of the 16th century, and taught that the essence of religion consisted in the feelings of divine love; hence they were otherwise called the Family of Love.

Familistère, fā-mē-lē-stär (Fr.), a community living as one family; a familistery. It is especially used as referring to the community established by Godin (q.v.) in Guise, France. See Guise.

Family, a category in the classification of animals and of plants, which falls between the narrower "genus" and the broader "group" order. It designates a natural group determined by the common possession of characters of a broader kind than those which determine the limits of a genus, and may be composed of many genera exhibiting the required affinity, or of only a single genus represented by one species. In the former case minor subdivisions may be convenient under the designation *sub-family;* an example of this occurs in *Falconidæ* (q.v.). On the other hand, certain groups of families, forming subdivisions of an order (q.v.), and called *super-families*, are sometimes made. In zoology a group of forms is ranked as a family on considerations of form as expressive of structure. This is sometimes very plain, as in the cat family, or the owl family; but frequently the limits are less easily marked, and the rank remains a subject of dispute pending the decisive results of better information. In zoology the technical name of a family, usually derived from that of its most typical or prominent genus, always ends in *idæ*.

In botany the corresponding category — that is, an assemblage of genera — is more frequently designated a "natural order," and its taxonomic name always ends in *aceæ*. It is based upon similar appearance and habit of growth and flowering, as the *Ranunculaceæ, Coniferæ*.

Family Compact, the name given to a compact organized by the Duke de Choiseul, first minister of Louis XV., between the various members of the Bourbon family, then sovereigns of France, Spain, the Two Sicilies, Parma, and Piacenza, mutually to guarantee each other's possessions. It was signed 15 Aug. 1761. It entailed on Spain a war with England, then at war with France. Other similar agreements, especially those of 1733 and of 1743 between France and Spain, bear the same name.

Family, Law of. See Law of Family.

Famine, a dire want of food affecting considerable numbers of people at the same time. Irregular rainfalls in tropical climates, imperfect methods of irrigation, or, as in Ireland, the too exclusive dependence of the mass of the people on a single article of food which happens to fail, are among the commonest causes of famines. In the early and mediæval ages they were frequent. The year 879 was one of universal suffering from lack of food. The famine of 1125 diminished the population of Germany one half. All through the Middle Ages public opinion upheld the city authorities in driving out of the gates the neediest inhabitants and letting them perish. In a famine which devastated Hungary in 1505 parents who killed and ate their children were not punished. It was after a famine of 1586 that the poor-law in England had its beginning. As late as the middle of the 17th century famines were a common affliction in Europe and even in the 18th century they still occurred. The last time a period of bad harvests was designated as a famine in Germany was in 1817. The rapidity of modern communication and transport has made severe famine almost impossible in western or central Europe or North America. In Ireland, famines more or less serious have at various times prevailed owing to failure of the potato crop. In 1846 the dearth was so great that 10,000,000 sterling were voted by Parliament for relief of the sufferers. India has long been subject to great famines, and the government's budget makes annual provision against such need. Under the rule of the English, the population has greatly increased, and as the majority of people live from hand to mouth in ordinary times, the slightest failure in the rice crop causes the famine point to be immediately reached. In 1769–70 as many as 3,000,000 perished; in 1865–6 about 1,500,000, and in 1877 about 500,000. The authorities grappled very successfully with the famines of 1896–7 and 1899–1900, which extended over large areas, yet there was great loss of life. The recent famine in India cost the government in 1900–1 $28,235,000, of which amount $21,135,000 was expended in direct relief. Apart from this $13,700,000 was advanced to native states for famine relief and $4,735,000 for special agricultural advances. Much help was sent from other countries, including very large contributions from the United States. In 1870–2 Persia lost 1,500,000 inhabitants, a quarter of the whole population. In China over 9,000,000 are said to have perished in 1877–8 from famine. In the northern provinces of Shensi, Shansi, and Honan, with a population of 56,000,000, during the years following 1877 it was reckoned that between 4,000,000 and 6,000,000 people perished, and famine visited the empire in 1903. In the famine of 1891–2 in Russia it was estimated that in 18 provinces 27,000,000 of inhabitants were affected. Although many of the causes of famine are beyond human control, it is probable that the extension of sound agricultural knowledge and the adoption of a more rational system as regards the kinds and quantities of crops grown will in the future render famine almost unknown in most countries.

Famine Fever. See Relapsing Fever.

Fan-Cheng, făn-cheng', China, city in the province of Hu-peh; on the Hankiang; 380 miles west of Nanking. It is located on one of the principal trade routes between the northern and southern provinces of China. Pop. 100,000.

Fan Coral, the spreading fan-like growths of corals of the family *Gorgonidæ*. The coral stock is here horny or calcareous and takes a bushy growth, or frequently spreads from its base into a flat network, making a "sea-fan." In this coral the short calicles of the single retractile polyps stand perpendicularly to the axis, in which run communicating canals. These alcyonarians are numerous not only in the tropics, one beautiful red or yellow species (*Rhipigorgia flabellum*) flourishing along the coast of Florida, but also in the deep cold waters of the North Atlantic.

Fan Cricket, a British name for the mole-cricket.

Fan Palm, a name common to all those palms which have fan-shaped (flabellate) leaves, but more particularly applied to those of the genus *Chamærops*, of which a common species in the Mediterranean region is *C. humilis*. The East Indian "great" fan palms are species of *Corypha*, one of which is the taliput-palm (*C. umbraculifera*), whose leaves furnish the "palm-leaf fans» of commerce. The West Indian fan palm is *Sabal blackburniana*.

Fan-tan, a Chinese word, *fan,* number of times; *tan,* apportion: a gambling game very popular with the Chinese. There are various forms of fan-tan, the simplest and most commonly played is that in which a pile of copper coins, usually cash, is covered with a bowl, the player staking or betting money on what the remainder will be when the pile of coins has been divided by four. As in the American game of poker there is a «kitty» or house-percentage in fan-tan, usually 8 per cent of the winnings being deducted for the benefit of the *croupier* or proprietor of the gambling house.

Fan Tracery, in architecture, the decorative tracery on the surface of fan vaulting. It was used in late pointed work. Fan vaulting or fan-tracery vaulting is a very complicated mode of roofing or vaulting in which the vault is covered with fan-tracery. It is peculiar to English Gothic, very fine examples of it being found in Henry VII.'s chapel, Westminster, and St. George's Chapel, Windsor.

Fanariots. See PHANARIOTS.

Fanaticism, excessive zeal; unreasoning enthusiasm in religious matters. In ancient Rome the term fanatics was applied to such as passed their time in temples, and who, pretending to be inspired by the divinity, would burst into wild and frantic gestures, utter pretended prophecies, cut themselves with knives, etc. It has prevailed under different forms in all ages of the world; and one of its most remarkable and dangerous features is the tendency that it has to spread over large masses of people, as well as to favor measures of persecution. By an extension of the term it is also sometimes applied to other forms of extravagant enthusiasm which in their outward manifestation are accompanied with impetuosity and violence. Thus, we speak of political fanaticism, which, in affairs of state, displays itself in a violent and intolerant partisanship. Not unfrequently both kinds of fanaticism are found combined, and to this combination most of the religious wars which have desolated kingdoms are to be ascribed.

Fandango, a lively and voluptuous Spanish dance in triple time, said to be derived from the Moors. It is danced by two persons, male and female, and accompanied by the sounds of the guitar. The dancers have castanets which they beat in time to the measure, though sometimes the male dancer beats a tambourine.

Faneuil, fan'el or fun'el, **Peter,** American merchant: b. of a French Huguenot family, New Rochelle, N. Y., 1700; d. Boston 3 March 1743. The project of erecting a public market-house in Boston had already been discussed for some years, when in 1740 Faneuil offered, at a public meeting, to build a suitable edifice at his own cost, as a gift to the town; but so strong was the opposition to market-houses that, although a vote of thanks was passed unanimously, the offer was accepted by a majority of only seven. The building was commenced in Dock Square in September of the same year, and finished in two years. It comprised a market-house on the ground floor, and a town-hall with other rooms over it. In 1761 it was destroyed by fire; in 1763 it was rebuilt by the town; and in 1775, during the English occupation of Boston, was used for a theatre. In 1805 it was considerably altered and enlarged. During the Revolutionary period it was the usual place of meeting of the patriots, and from the stirring debates and important resolutions which were often heard within its walls, it gained the name of «the cradle of American liberty.» It was extensively restored in 1900. The hall is some 80 feet square and contains many portraits and the large painting ‘Webster replying to Hayne.’ The lower story is still occupied as a market.

Faneuil Hall («The Cradle of Liberty»), in Dock Square, Boston. There being no public market in Boston in 1740, Peter Faneuil offered to build one and give it to the city. It was finished in 1742,— a two-story brick building 100 by 40, containing not only a market in the basement, but rooms for town officers and a public hall for town meetings. It was destroyed by fire 13 Jan. 1761; rebuilt 1763, and used for town meetings during many years following. In 1805 it was doubled in size by adding a third story and moving a side wall back 40 feet, making the great hall (it holds 3,000 people) famous for the speeches of Webster, Choate, Sumner, Wendell Phillips, Everett, and others. The building is still used both for hall and market; the former contains some fine paintings, including Healy's ‘Webster Replying to Hayne.’ See Brown, ‘Faneuil Hall and Market’ (1901).

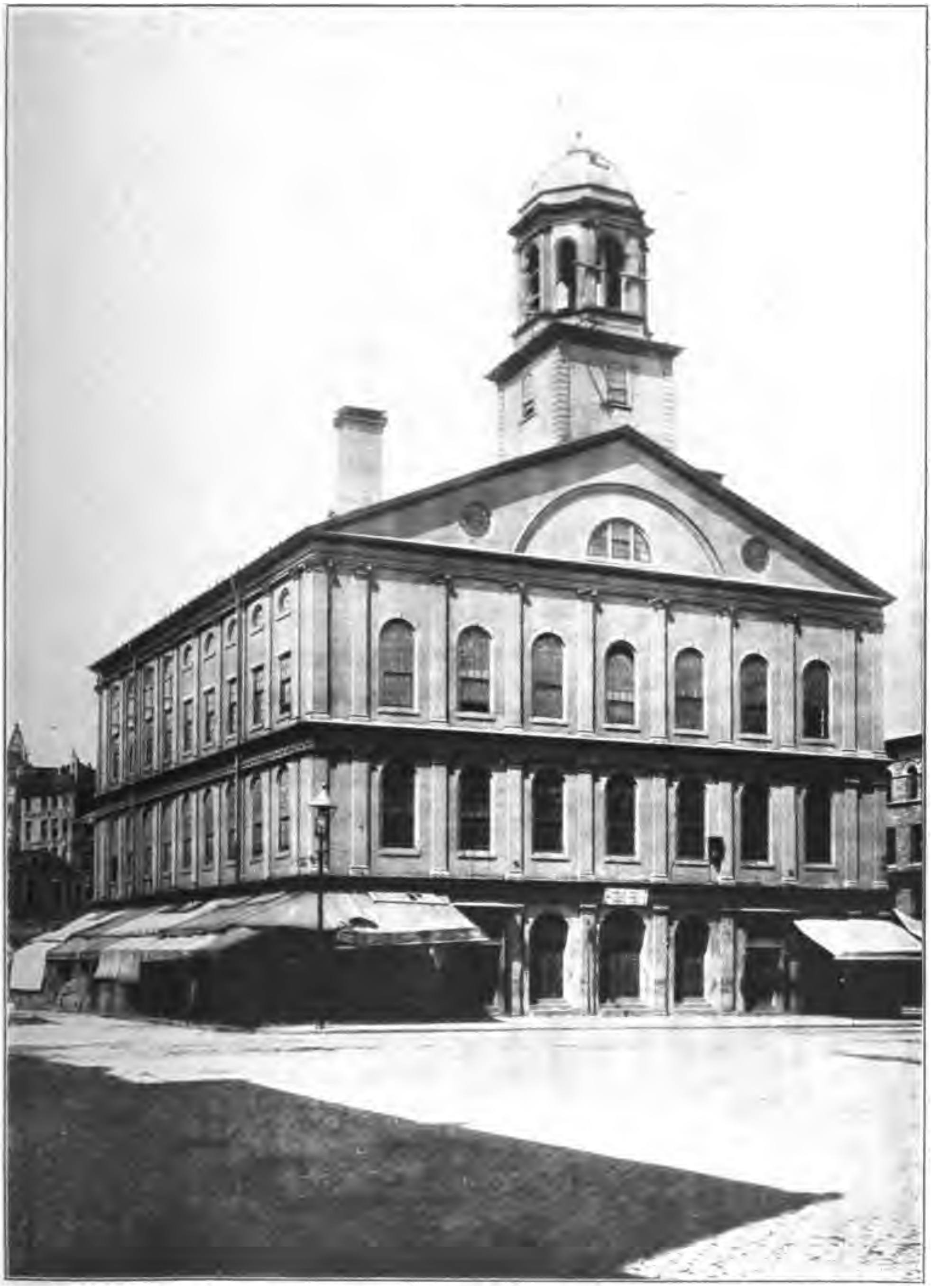
Fanfani, Pietro, pē-ā trō fān-fā'nē, Italian philologist, humorist, and novelist: b. Pistoia, Italy, 21 April 1815; d. Florence 4 March 1879. He founded in 1847 the ‘Philological Record,’ and afterward edited several other periodicals of a like character. His «vocabulary of Tuscan Usage» and other «vocabularies» are works of high authority. The ‘Writ at Random,’ and the whimsical satire ‘The Laughing Democritus: Literary Recreations,’ furnish examples of his brimming humor. His novels are: ‘Cecco of Ascoli’; ‘Paolina’; ‘The Coachman and his Family’; etc.

Fanfare, in music, a short passage for trumpets. Certain flourishes in opera music are also called fanfares. Also any short, prominent passage of the brass instruments of an orchestra.

Fangwe. See FANS, a tribe.

Fannin, James W., American soldier: b. Georgia about 1800; d. Goliad, Texas, 27 March 1836. He removed to Texas in 1834 and in the Texas war of independence raised the «Brazo's Volunteers,» a company which formed part of the army of Gen. Austin. Receiving orders from Gen. Houston to blow up Goliad and retire to Victoria he was attacked on the banks of Coleto Creek as he was retreating with women and children and a force of 350 men. The Mexicans were 1,200 strong and after a battle of two days he surrendered. Santa Anna instead of paroling the Americans, in accordance with the promise of Gen. Urrea, gave orders that all, excepting the women and children, should be shot.

Fanning, David, American freebooter: b. Wake County, N. C., about 1756; d. Digby, Nova Scotia, 1825. He was a carpenter by trade, but led a vagabond life. Late in the Revolutionary War he joined the Tories for the purpose of revenge; gathered a small band of despera-



FANEUIL HALL, BOSTON, MASS.

does like himself, laid waste to whole settlements and committed fearful atrocities. For these services he received a lieutenant's commission from the British commander at Wilmington. At one time he surprised a court in session and captured and carried off judges, lawyers, clients, officers, and citizens, and soon afterward seized Gov. Burke and his suite. The name of Fanning became a terror to the country, and he was outlawed. At the close of the war he fled to New Brunswick, where he became a member of the legislature.

Fanning, Edmund, American loyalist: b. Long Island, N. Y., 1737; d. London, England, 28 Feb. 1818. He was graduated from Yale in 1757; settled in North Carolina, where he became a member of the legislature, and as recorder for Orange County excited general dislike by his exactions. In 1771 he removed to New York and in 1777 organized the king's American regiment of foot. He was subsequently appointed governor of Nova Scotia by the English government and was governor of Prince Edward Island 1786–1805. In the English army he rose to the rank of general.

Fanning, John Thomas, American civil engineer: b. Norwich, Conn., 31 Dec. 1837. He served in a Connecticut regiment during the Civil War and was city engineer of Manchester, N. H., 1872–86. Since the last named year he has lived in Minneapolis. He has been connected with the planning and construction of various important public waterworks in New England and in the western States, and has published 'A Treatise on Hydraulic and Water Supply Engineering' (1877).

Fanning Islands, a group of coral islands, in the Pacific, between lat. 2° and 5° 49′ N., and lon. 157° and 162° W. It comprises the islands of Jarvis, Christmas, Washington, Palmyra, and Fanning Island; area of the whole, about 260 square miles. Cocoanut and other tropical trees are found here. The islands of Fanning and Christmas belong to Great Britain. The group gets its name from an American sailor, Edmund Fanning, who discovered it in 1798.

Fanny, Aunt. See Barrow, Frances Elizabeth.

Fanny Fern. See Parton, Sarah Payson Willis.

Fano, fä'nō (ancient Fanum Fortunæ), a seaport of Italy, in a rich and fertile plain on the Adriatic, province of Pesaro e Urbino, 29 miles northwest of Ancona. It is surrounded by walls, built by the Emperor Augustus, and contains a triumphal arch, a cathedral with valuable paintings, a public library, and a fine theatre. Pop. commune 24,848.

Fanon, an ecclesiastical term of various applications. It was used to denote the cloth in which the deacon in the ancient or early mediæval Church received the oblations, and is now generally applied to a striped, oblong piece of silk gauze worn on the head and shoulders by the Pope in celebrating mass pontifically. It also designates the church banner carried in processions. In surgery, a fanon is a splint of a particular shape, formerly employed in fractures of the thigh and leg, to keep the bones in contact.

Fans, also known as **Fangwe Pahouins, Oshiba,** etc., an African people who emigrated from the interior to the coast of French Congo during the first half of the 19th century. They now number about 300,000 in the neighborhood of the mouths of the Ogoway and the Gaboon. They have been described by Du Chaillu, Burton, Lenz, Reade, and other travelers as a warlike and highly intelligent people, differing markedly from the surrounding negroid or Bantu tribes. Their complexion is rather light, their beard long, their frontal bone very prominent, and they are tall and well-built. They were formerly much given to eating human flesh, but their cannibalistic tendencies have been checked by contact with the Europeans of the coast regions.

Fans, instruments for producing an agitation of the air, and consisting of an extended flat surface, generally semicircular in outline. As hand-implements for cooling the air they have long been articles of luxury. Early Egyptian paintings prove familiarity with its use in a remote period. From a passage in the 'Orestes' of Euripides it appears that the Grecian fans were introduced from the East, that they were of a circular form, and were mounted plumes of feathers. Dionysius of Halicarnassus describes the courtiers of Aristodemus at Cumæ as attended by females bearing parasols and fans. Plautus mentions fan bearers as forming part of a Roman fine lady's retinue, and Suetonius describes Augustus as lying, during the heat of summer, in the shade, and fanned by an attendant. In the Middle Ages fans were used in the churches to chase away the flies from the holy elements of the Eucharist. Such a fan, known as a flabellum, is still used in the Greek and Armenian churches. The folding fan is said to have been a Japanese invention which originated in the 7th century, the idea having been supplied by the wing of the bat. From Japan the invention passed into China; but it was not till about the beginning of the 16th century that such fans began to be used in Europe, being introduced into Italy and Spain. The fan was first brought into European notoriety by Catharine de Medici, who introduced it in the folding form into France. Great sums were spent on the ornamentation of the fans first in vogue, and many were painted by Watteau. During the 16th and 17th centuries, they were used by gentlemen. In various nations and at various periods the manipulation of the fan has formed almost a separate language, especially for coquettes. Addison in his essay on the fan, in the 'Spectator,' and Disraeli in 'Contarini Fleming,' treat of this feminine art. They are said to have been introduced into England from Italy in the reign of Henry VIII.; and in the reign of Elizabeth they were framed of very costly materials, the body of ostrich feathers, the handle of gold, silver, or ivory, of curious workmanship. Walking fans were formerly in use. They were of large size and were employed to screen the face from the sun. The Chinese have greatly excelled in the art of making fans, those of the lacquered variety showing especial skill. For common use they make a cheaper sort, constructed of polished bamboo and paper. In Japan, where to this day the fan is an indispensable adjunct of the daily life of all classes, large rich fans are used in ceremonial dances in which they are accessories of peculiar significance. In Rome the pope is escorted on ceremonial occasions by attendants with flabella formed of peacock feathers. In Europe, France manufactures the greatest number of fans used by the world of fashion. A species of large fan known as a punkah is used in India for cooling the air of rooms and keeping down the temperature. Fans in the form of machines are used in agriculture for winnowing grain, the original form being very simple and dating back to primitive times. In metallurgy and other branches of manufacture fans are employed for ventilating and stimulating the combustion of fires; for the ventilation of mines; and for various other manufacturing purposes. The modern electric revolving fan is extensively used for cooling the air in public and private buildings.

Fans, Mine. See MINING.

Fanshawe, fan'shâ, **Anne Harrison,** LADY, an English memoirist: b. London, England, 25 March 1625; d. there 30 Jan. 1679 or 1680. Her admirably written and accurate observations of life and manners in many lands, preserved in ‹Memoirs,› from which extracts have been published, are of historical value.

Fanshawe, Catharine Maria, English poet: b. Chipstead, Surrey, England, 6 July 1765; d. Putney Heath, Surrey, 17 April 1834. A lively fancy, brilliant wit, sound sense, and personal charm made this lady and her poetry admired in her own circle; but she rarely consented to publication, and only her riddle on the letter H, sometimes credited to Byron, is generally known, her stanzas not having been collected.

Fanshawe, SIR **Richard,** English diplomatist, poet, and translator: b. Ware, Hertfordshire, June 1608; d. Madrid, Spain, 26 June 1666. On the breaking out of the civil wars in 1641 he engaged actively in the royal cause. He was made a baronet in 1650, and sent on an embassy to Spain, and afterward appointed secretary of state for Scotland. He was taken prisoner at the battle of Worcester in 1651. In 1661 and 1662–3 he was employed on two several missions to the court of Lisbon, in the former of which he negotiated the marriage of Charles II. with Princess Catharine, and on his return in 1663 was advanced to a seat in the privy council. In 1664 he was sent ambassador to Madrid, and negotiated a peace between England, Spain, and Portugal. His poetical abilities were above mediocrity, as is evinced by his translations of the ‹Lusiad› of Camoens, the ‹Pastor Fido› of Guarini, the ‹Odes› of Horace, and the fourth book of the ‹Æneid› into English verse, and Fletcher's ‹Faithful Shepherdess› into Latin.

Fantail, an Australian flycatcher of the genus *Rhipidura,* having a fan-like, and in some species prolonged, tail, which the bird opens and shuts gracefully as it tumbles about in the air when pursuing its agile prey. A familiar species is *R. mottacilloides,* whose habits are wagtail-like.

A warbler (*Cisticola cursitans*) of the Mediterranean countries and eastward, remarkable for its nest, which consists of soft materials enclosed in two leaves stitched together to sustain it, much after the method of the tailor-bird (q.v.).

A small variety of domestic pigeon, usually pure white, which holds its tail erect and distended like a fan.

Fantasia, fan-ta-zē'a, in music, a species of composition in which the author confines himself to no particular form or theme, but ranges as his fancy leads amid various airs and movements. Some writers, in defining this word, confine its meaning to extempore composition, and make this distinction between capriccio and fantasia; namely, that the former is a collection of singular and whimsical ideas strung together by an excited imagination, and written down at one's leisure, but the latter is an off-hand execution of whatever comes across the mind while playing on an instrument.

Fantee, or **Fanti,** făn-tē', a country of Africa, on the Gold Coast, which extends about 90 miles along the shore of the Atlantic, and 70 inland; lat. 5° 30′ N.; lon. 1° W. The inhabitants, called Fantees, were at one time the most numerous and powerful people situated immediately on the Gold Coast; but their power was almost entirely broken after 1811 by invasions of the Ashantees. Their country now forms a district of the British Gold Coast Colony. The soil is fertile, producing fruits, maize, and tropical vegetation of nearly every variety. The custom of making small scarifications on the upper part of the cheek-bones and the back of the neck prevails among the Fantees. Their government is aristocratic. Their head chief is supreme judge or governor, and is attended by a council of old men. Each town has a chief. At one time they had several large cities. The country of the Fantees is populous and prosperous, owing to the protection afforded by the British settlements, and particularly by Cape Coast Castle. In 1873 they were again attacked by the Ashantees, who also threatened the British settlements, and compelled the government of Great Britain to send out an expedition under Sir Garnet (now Lord) Wolseley to suppress them. Consult: Barrow, ‹Fifty Years in Western Africa›; Boyle, ‹Through Fanteeland and Coomassii›; McDonald, ‹The Gold Coast Past and Present.›

Fantoccini, făn-tō-chē'nē, an exhibition of puppets, or a dramatic representation on a small scale, performed by figures or dolls, an amusement of which the Italians are extremely fond, and which is frequently performed in a portable theatre — like that of Punch and Judy.

Fanum Fortunæ. See FANO.

Far from the Madding Crowd, a novel by Thomas Hardy, published 1874. It is perhaps the best example of his earlier manner, and of his achievements in the domain of comedy.

Farad (from Michael Faraday), the standard electrical unit, which is measured by the capacity of a condenser that with an electromotive force of one volt is able to overcome a resistance equivalent to one ohm in one second, or in other words the resistance offered by a cylindrical copper wire, 250 feet long, 1/20 inch in diameter, the ohm being the magneto-electric unit. See ELECTRICAL UNIT.

Faraday, Michael, English scientist: b. Newington Butts, England, 22 Sept. 1791; d. Hampton Court 25 Aug. 1867. He received little or no education and was apprenticed to the trade of a bookbinder. During his term of apprenticeship, a few scientific works fell into his hands, which he read with avidity, and forth-

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with devoted himself to the study of, and experiments in, electricity. Having attended the lectures given in 1812 by Sir Humphry Davy, and taken notes thereon, he sent them to that philosopher, and besought some scientific occupation. The reply was prompt and favorable. In 1813 Faraday was appointed chemical assistant, under Sir Humphry, at the Royal Institution. Faraday discovered in 1820, the chlorides of carbon, and, in the following year, the mutual rotation of a magnetic pole and an electric current. These were strong encouragements to proceed on the path of discovery, and led to the condensation of gases in 1823. In 1829 he labored hard, and, as he thought at the time, fruitlessly, on the production of optical glass; but though unsuccessful in his immediate object, his experiments produced the heavy glass which afterward proved of great assistance to him in his magnetical investigations. In 1831 the series of 'Experimental Researches in Electricity,' published in the 'Philosophical Transactions,' began with the development of the induction of electric currents, and the evolution of electricity from magnetism. Three years later Faraday established the principle of definite electrolytic action, and, in 1846 received at the same time the Royal and the Rumford medals for his discoveries of diamagnetism, and of the influence of magnetism upon light respectively. In 1847 he discovered the magnetic character of oxygen, and, also, the magnetic relations of flame and gases. His papers, including other contributions to the store of modern science, are too numerous to mention in detail. It should be observed that the 'Researches,' though termed 'Experimental,' contain many hypothetical ideas, and many inquiries into theories generally adopted up to their time. Among these may be specified the considerations respecting static induction, atmospheric electricity, and those relating to lines of force, both physical and representative, on which having sufficiently stated his views, he was content to leave them for solution to time and future experience. It may be added that his last hypothetical view relates to the conservation of force, and that one of his latest papers treats of the division of gold and other metals. In 1833 Faraday was appointed professor of chemistry in the Royal Institution, London, which chair he continued to hold until his death. In 1835 he received from government a pension of $1,500 per annum in recognition of his eminent scientific merits. In 1836 he was appointed a member of the senate of London University. From 1829 to 1842 he was chemical lecturer at the Royal Academy. In 1823 Faraday was elected corresponding member of the French Academy. In 1825 he was chosen a Fellow of the Royal Society, and in 1832 made a D.C.L. of Oxford University. He was, besides, a knight of several of the European orders, and a member of the chief learned and scientific societies in Europe and the United States. See Tyndall, 'Faraday as a Discoverer' (1868); Bence Jones, 'Life and Letters' (1870); J. H. Gladstone, 'Life of Michael Faraday' (1872); Thompson, 'Michael Faraday: his Life and Work' (1898).

Faraday Effect. See LIGHT.

Faradism. See ELECTRICITY IN MEDICINE.

Farafeh. See FARAFRA.

Farafra, fa-rä'fra, or **Farafeh,** an oasis of the Libyan Desert, in Africa, containing several ruins of Greek and Roman origin. A coarse woolen cloth and earthenware are the manufactures.

Farallones (fä räl-yō'nes) **Islands,** in the Pacific, off the coast of California, about 28 miles from the entrance to the Golden Gate; a group of six small rocky islands. A large number of rabbits are found on the islands and many sea-lions on the coast. The islands are owned by a company who market the eggs of the sea-gulls and murres (allied to the auk). A lighthouse, with all modern equipment, on the southern island, is 360 feet above the water.

Farandola, fa-ran'-dō la or **Farandole,** fa-ran'dōl, a dance with various figures, popular among the peasants of the south of France and the neighboring part of Italy. It is performed by men and women taking hands, and forming a long line, and winding in and out with a waving motion. The dance is often used in excited gatherings. The figures of the farandola, by the name of the Spanish dance, were once well known in English ball-rooms.

Farce (Ital. *farsa,* from Lat. *farcire,* "to stuff"), a dramatic piece of a broad comic character. The difference between it and comedy proper is one of degree and not of kind. The aim of both is to excite mirth; but, while the latter does so by a comparatively faithful adherence to nature and truth, the former assumes a much greater license, and does not scruple to make use of any extravagance or improbability that may serve its purpose. It does not, therefore, exhibit, in general, a refined wit or humor, but consists of ludicrous rencontres, exaggeration of personal peculiarities, and dialogues provocative of fun. The beginnings of Greek and Roman comedy consist of rustic farces or pantomimes (see ATELLANÆ FABULÆ); the first farces, in the modern sense, were composed by the fraternity of the Bazoche (q.v.) in Paris, as a contrast to the ecclesiastical plays performed by the religious orders. The most widely celebrated and most important of early farces is that of the advocate 'Maistre Pierre Patelin,' which was acted in the 15th century, and quickly spread itself over Italy and Germany. It is full of genuine comic quality, and its dialogue has brightness and reality. The *commedia dell 'arte* of Italy were of a farcical nature. Molière elevated and refined the farce into his wonderful series of comedies of character. In England the origin of the modern farce dates from about the commencement of the 18th century. Few farces have kept a place in literature. See COMEDY; DRAMA.

Consult: Chevaldin (L. E.), 'La Farce de Patelin et ses Imitations' (Paris 1889), from the work by Dr. K. Schaumburg.

Farcy, in horses, depends upon the same causes as glanders (q.v.) — in fact, is an outward manifestation of glanders. The absorbent vessels of the superficial parts of the body, but usually those of one or both hind limbs, are inflamed, tender, swollen, hard, and knotted. The vitiated lymph thus poured out softens, and ulcers or farcy buds appear. Unlike the ulcers of glanders, they are sometimes thought to be curable, but an animal apparently cured is not safe to be with other horses, as the *contagium* —

the *Bacillus mallei* — almost invariably remains, and the animal is thus a centre of infection and a source of danger.

Fardel-bound, a term applied to sheep and cattle when suffering from a disease caused by the retention of food in the third stomach, or maniplies. The disease frequently arises from the eating of over-ripe clover, vetches, or rye grass. The food being tough and indigestible, finally causes chronic inflammation.

Fareham, fār'ạm, England, a market town in Hampshire, at the head of a short arm of the Portsmouth harbor, and six miles northwest of Portsmouth.

Farel, Guillaume, gē yōm fä-rel, Swiss reformer: b. near Gap, Dauphiny, 1489; d. Neufchâtel, Switzerland, 13 Sept. 1565. At an early period the study of the Bible led him to reject many of the chief doctrines of the Roman Catholic Church. At Basel, in 1524, he publicly sustained several theses in support of Protestantism, and he afterward preached in Strasburg, Montbéliard, and elsewhere. In 1530 he secured the public adoption of the reformed doctrines in Neufchâtel. Geneva, however, became the principal scene of his labors. Here, in the religious conferences of 1534 and 1535, he defended his beliefs so successfully that the reformed parishes not only obtained permission to hold public religious services, but the council formally embraced the Reformation. In concert with Calvin he took an active part in 1536 at the disputation in Lausanne, when the Reformation was embraced. In consequence of a quarrel, arising out of an attempt to enforce a stricter moral discipline, he was banished from Geneva in 1538, and ultimately took up his residence in Neufchâtel. See Life, by Bevan (1893).

Fargo, William George, American capitalist: b. Pompey, N. Y., 20 May 1818; d. Buffalo, N. Y., 3 Aug. 1881. He became Buffalo agent of the Pomeroy Express Company in 1843; established the first express company west of Buffalo, in 1844; and in 1868 became president of the great corporation controlling the whole West, the Wells-Fargo Express Company.

Fargo, N. D., city, county-seat of Cass County; at the head of navigation on the Red River; on the Chicago, M. & St. P., the Northern P., and the Great N. R.R.'s; opposite Moorehead, Minn. It contains a United States land office, Fargo College (Cong.), the State Agricultural and Mechanical College, St. John's Hospital, high school, court-house, waterworks, street railroad, and electric light plants, several banks, and a number of daily and weekly newspapers. It has the car shops of the Northern Pacific Railroad, flour-, planing-, and paper-mills, large grain elevators, a brewery, and large brick yards. Pop. (1910) 14,331.

Fargo College, a coeducational institution in Fargo, N. D.; founded in 1888 under the auspices of the Congregational Church. In 1910 there were in attendance 376 students.

Fargus, Frederick John («Hugh Conway»), English novelist: b. Bristol, England, 26 Dec. 1847; d. Monte Carlo 15 May 1885. He adopted his pseudonym from the school frigate Conway, stationed on the Mersey, which he entered when he was 13, for the purpose of training for a seafaring life. He subsequently entered the auctioneer business, employing his leisure in writing clever newspaper verse and occasional tales. Some songs of his were accepted and published in 1878, a volume of verse in 1879; but it was the issue and rapid sale of his melodramatic story, 'Called Back' (1884), which made him famous. He then went to London, where he adopted the profession of authorship. His other writings include: 'Dark Days' (1884); 'A Family Affair' (1886); 'Slings and Arrows'; 'A Cardinal Sin' (1883); 'Bound Together' (1884).

Faria, fä-rē'ä, **Manoel Severim de**, Portuguese author: b. Lisbon, Portugal, 1583; d. Evora 25 Sept. 1655. He devoted many years to the study of his country's literature, giving his researches and thought a lasting form in 'Various Essays' (1624), containing appreciations and biographies of Camoens and other great writers. He also wrote 'Jottings of Portugal' (1655).

Faria y Sousa, fā-rē'ā ē sō'zā, **Manoel**, Portuguese historian and lyric poet: b. near Pombeiro, in Portugal, 18 March 1590; d. Madrid, Spain, 3 June 1649. A passion for a beautiful girl first awakened his poetical genius. He celebrated her under the name of Albania in his sonnets, married her in 1613, and went to Madrid. But he did not succeed there, and returned to Portugal. He also visited Rome, and gained the notice of Urban VIII. Among his writings are: 'Discursos Morales y Politicos'; 'Epitome de las Historias Portuguesas'; and a collection of poems called 'Fountain of Aganippe' (Fuente de Aganipe, Rimas varias, 1644–6). His style was pure and strong, and his descriptions full of vigor.

Faribault, fār-ĭ-bō', Minn., city, county-seat of Rice County; at the confluence of the Cannon and Straight rivers; on the Minneapolis & St. L. and the Chicago, M. & St. P. R.R.'s; 53 miles south of St. Paul. It has manufactories of pianos, carriages, furniture, boiler works, foundry products, and rattan goods, and canning establishments, breweries, flour-, planing-, and woolen-mills. Faribault is noted for its fine schools, both public and private. The State schools for the deaf, dumb, blind, and feeble-minded are located here. The Seabury Divinity School, the Shattuck Military School for boys and the St. Mary's School for girls are flourishing institutions, all three of which are under the auspices of the Protestant Episcopal Church; Bethlehem Academy is in charge of the sisters of St. Dominic. Faribault was the home of Bishop Whipple (q.v.). Faribault became noted in 1891, because of a controversy which arose regarding the incorporation of parish schools into the public school system. It was called by many then a new movement; but it was similar to the plans which had long been in existence in several cities and towns in other parts of the United States; as Poughkeepsie, Corning, Ogdensburg, and Plattsburg in the State of New York; and several places in Connecticut, Ohio, and in other States. Pop. (1910) 9,001. See PARISH SCHOOLS.

Faridpur, Furidpur, fŭr-ēd-poor, or **Dacca Jelalpur**, däk'kä jel-ŭl-poor', a district in the Dacca division; area, 2,267 square miles. Pop. about 1,800,000.

Farina, fā-rē'nā, **Salvatore**, Italian novelist: b. Sorso, Sardinia, 10 Jan. 1846. His tales were successful from the first, which was ‘Two Amours’ (1869). Among the others are: ‘A Secret’ (1870); ‘Forbidden Fruit’; ‘Romance of a Widower’; ‘Doumina’s Treasure’; ‘Courage and Onward’; ‘Little Don Quixote’ (1890); ‘Living for Love’ (1890); ‘For Life and for Death’ (1891). The sympathy with lowly life and the rich humor of his stories have gained him the title of “The Italian Dickens.” He is the best known abroad of all Italian novelists.

Farina (Lat. “flour”), a term popularly applied to a food product made from white maize, having grains coarser than those of meal, but finer than hominy. A somewhat similar preparation is made from the inner portion of wheat grain. Farinaceous dishes, in which farina is combined with milk, fruit, etc., furnish a light and nutritious diet for invalids and the young. In early works on botany the pollen of flowers was styled farina.

Farinato, fă-rē-nă'tō, or **Farinati,** fă-rē-nä'tē, **Paolo,** Italian painter: b. Verona 1524; d. there 1606. He took his style of painting from Veronese, and Guilio Romano. His works are characterized by wealth of imagination, graceful but not always correct drawing, combined with harmonious coloring. He finds his modern counterpart in the English Rosetti. He painted both in oil and fresco. There are some fine frescoes of his in the choir of San Nazaro at Verona; his wonderful ‘Miracle of the Bread and Fishes’ (1603) is in the church of San Georgio Maggiore, and his ‘Finding of Christ in the Temple’ is in the Berlin Museum.

Farinelli, fä-rē-nel'lē (real name Carlo Broschi), Italian soprano singer: b. Naples 24 Jan. 1705; d. Bologna 15 Sept. 1782. He studied under Porpora, and went from Rome to Vienna, where the Emperor Charles VI. loaded him with rich presents. In 1734 Farinelli went to London, and by the magic of his singing so delighted the public that Handel was obliged to dismiss a rival company over whom he presided, in spite of all his powers and popularity. Many extraordinary stories are related of Farinelli's vocal skill, and his command over the feelings and sympathies of his audience appears to have been unrivaled.

Faringdon, făr'ing-dȯn, or **Great Faringdon,** England, a market town in the county of Berks; 16 miles southwest of Oxford. Pop. 3,133.

Farini, Luigi Carlo, loo-ē'jē kär'lō fä-rē'-nē, Italian historian: b. Russi 22 Oct. 1812; d. 1 Aug. 1866. He studied medicine at Bologna, but early entered upon a political career, becoming minister of public instruction in 1850, of commerce in 1861, and president of the council in 1862 during Cavour's administration. His influence contributed much to the union of central Italy with the kingdom of Victor Emmanuel II. His ‘History of the Roman State from 1815 to 1850’ (1850) was translated into English; and his ‘History of Italy,’ a continuation of Botta's celebrated work, is a performance of standard merit.

Farjeon, fär'jun, **Benjamin Leopold,** English novelist of Jewish descent: b. London 1833; d. Hampstead 1 Aug. 1903. He spent some years in Australia and New Zealand as journalist and novelist, and was the editor and co-proprietor of the first daily newspaper published in the latter country. His first successful novel was ‘Grif: a Story of Australian Life’ (1870). It was followed in 1871 by ‘Blade-o'-Grass,’ and in 1872 by ‘Joshua Marvel.’ Later works of his include: ‘London's Heart’ (1873); ‘Bread and Cheese and Kisses’ (1874); ‘Love's Victory’ (1875); ‘At the Sign of the Silver Flagon’ (1876); ‘Solomon Isaacs: a Christmas Story’ (1877); ‘Aaron the Jew’; ‘Great Porter Square: a Mystery’ (1884); ‘The House of White Shadows’ (1884); ‘Self-doomed’ (1885); ‘Set in a Silver Sea’ (1886); ‘The Nine of Hearts’ (1886); ‘The Tragedy at Featherstone’ (1886); ‘The Secret Inheritance’ (1887); ‘Toilers of Babylon’ (1888); ‘Miriam Rozella’ (1897); ‘The Betrayal of John Fordham’ (1897); ‘Samuel Boyd of Catchpole Square’ (1899); ‘The Mesmerists’ (1900); ‘Pride of Race’ (1900); ‘The Mystery of the Royal Mail’ (1902); etc. Farjeon has been compared with Dickens in his “sentiment and minute characterization.” The comparison is not altogether a happy one, and the knowledge that it had been made affected the novelist's style somewhat, and not for the better.

Farley, Harriet. See Donlevy, H. F.

Farley, James Lewis, Irish journalist: b. Dublin, Ireland, 9 Sept. 1823; d. London, England, 12 Nov. 1885. Established in Turkey as a bank official, he became correspondent of two or three great London dailies and speedily made himself an authority on Turkish questions. His books include: ‘The Resources of Turkey’ (1862); ‘Turkey: Its Rise, Progress, and Present Condition’ (1866); and ‘Modern Turkey’ (1872).

Farley, John Murphy, American Roman Catholic prelate: b. Newton, Hamilton, county of Armagh, Ireland, 20 April 1842. He began his college studies in Ireland, although only a youth when he came with his parents to America. He continued his studies for the priesthood in St. John's College, Fordham, N. Y., and St. Joseph's Seminary, Troy, N. Y., and in the American College in Rome. He was ordained in Rome 11 June 1870, and the same year returned to the United States to begin work in St. Peter's parish, New Brighton, Staten Island. In 1872 Archbishop McCloskey of New York chose him for private secretary. In 1884 Pope Leo XIII. made him private chamberlain with the title monsignor; and in 1891 he was made vicar-general of the archdiocese of New York. In 1892 he was made domestic prelate to Leo XIII., and in 1895 prothonotary apostolic, all of which positions gave him special privileges. In December 1895 he was consecrated titular bishop of Zeugma, and became assistant to the archbishop of New York. For several years he was permanent rector of St. Gabriel's Church, New York.

When the see of New York became vacant by the death of Archbishop Corrigan (1902), the lists of names sent to Rome by the suffragan bishops and permanent rectors, each had at the head the name of Bishop Farley as first choice for archbishop. He received his appointment from Leo XIII., but the pallium was conferred under Pius X., on 12 Aug. 1903. He is the fourth archbishop of New York and governs one of the largest Roman Catholic dioceses in the world, containing about 1,200,000 members of the Church. He is the metropolitan of the ecclesiastical province of New York, which is composed of eight dioceses outside the archdiocese; six in the State of New York and two in New Jersey. The author of the 'Life of Cardinal McCloskey,' Archbishop Farley has also been a contributor to various magazines, and takes great interest in movements for the social welfare of the city. He was created cardinal by Pope Pius X, 30 Nov. 1911. At present (1912), the archdiocese of New York comprises a Catholic population estimated at 1,400,000; 800 priests; 300 churches; 200 parochial schools; 1 theological seminary; 6 orphanages; 20 hospitals and other institutions, benevolent and educational.

Farlow, William Gilson, American botanist; b. Boston, Mass., 17 Dec. 1844. After graduating at Harvard, he spent several years in Europe pursuing his favorite study and became professor of cryptogamic botany at Harvard in 1879. His publications treat mainly of marine algæ, fungi, and diseases of plants. Upon these subjects, and particularly upon cryptogamic botany, he is considered an authority. He also published: 'The Potato Rot' (1875); 'Diseases of Olive and Orange Trees' (1876); 'The Marine Algæ of New England' (1881).

Farm, a tract of land devoted to agriculture, under the management of owner or tenant. The size of farms and their tenure differ very much in different countries. On the continent of Europe, where peasant proprietaries, cultivation by the metayer system (q.v.), and mixed tenures prevail, farms are generally small. In England, where the land is in the hands of a comparatively small number of proprietors, and is let out to farmers who pay a fixed rent and make a trade of cultivating their holdings, these are in many localities large compared with continental farms. In the United States the majority of farms are owned by those who operate them. In 1900 between 54 and 55 per cent were so operated. In 1890 tenants operated 28.4 per cent of all the farms, and in 1900, 35.3 per cent. A comparatively small number are worked by part owners. The short tenure of land usually prevailing in England and Ireland has given rise to many disputes about compensation for improvements effected by tenants, etc. In Scotland it has been customary to give a lease for 19 years.

In these statistics the term "farm" includes, as defined by the twelfth census of the United States, "all the land, under one management, used for raising crops and pasturing live stock, with the wood lots, swamps, meadows, etc., connected therewith. It includes also the house in which the farmer resides, with all other buildings used by him in connection with his farming operations." As thus broadly defined the 5,739,657 farms in the United States in 1900 embraced, in addition to the general farm, the cotton, the sugar, and the rice plantations of the country; large ranges in the western States (of which however the area actually owned or leased is very small) — as well as smaller stock farms — the extensive farms devoted to the raising of grain; those producing chiefly hay and forage, tobacco, hemp, or hops, orchard fruits or small fruits; truck farms; dairy farms; poultry farms; bee farms; florists' establishments; nurseries, etc. The number of farms in the United States has increased so rapidly for several decades that in 1900 there were nearly four times as many as in 1850 and 25.7 per cent more than in 1890. Since 1880 the average size of farms has increased, being in 1900 146.6 acres. The number of farms under 3 acres is 41,882; and of farms of 1,000 acres and over 47,276. The medium-sized farms containing from 100 to 174 acres represent the highest value per acre. The total value of farm property in the United States is a little over $20,514,000,000. See AGRICULTURE; DAIRY INDUSTRY, AMERICAN; LIVE STOCK; FARM MACHINERY, AMERICAN.

Farman, Elbert Eli, American jurist: b. New Haven, Oswego County, N. Y., 23 April 1831. He was graduated at Amherst College in 1855, and admitted to the bar in 1858 and to the United States courts in 1862. He studied international law in Berlin and Heidelberg, Germany, in 1864–7; was district attorney of Wyoming County, N. Y., in 1868–75; United States diplomatic agent and consul-general at Cairo, Egypt, in 1876–81; was a member of the International Commission to revise the judicial codes of Egypt in 1880–1; judge of the mixed tribunal of Egypt in 1881–4; and United States member of the International Commission which examined the claims of the inhabitants of Alexandria for losses arising from the bombardment in 1882, 1883, and 1884. He secured the obelisk "Cleopatra's Needle" as a gift of the khedive to New York, in 1879; made large collections of ancient coins and Egyptian antiquities which he gave to the Metropolitan Museum of Art in New York.

Farman, Ella. See PRATT, ELLA FARMAN.

Farmer, Henry Tudor, American poet: b. England 1782; d. Charleston, S. C., January 1828. While very young he emigrated to Charleston, S. C., where he continued to reside till his death. He published a small volume of poems entitled 'Imagination, the Maniac's Dream, and Other Poems' (1819); also an 'Essay on Taste.'

Farmer, John, American genealogist: b. Chelmsford, Mass., 12 June 1789; d. Concord, N. H., 13 Aug. 1838. He published in 1829 a much valued 'Genealogical Register of the First Settlers of New England.'

Farmer, Lydia Hoyt, American miscellaneous writer: b. Cleveland, Ohio, 1842; d. 27 Dec. 1903. She was married to E. J. Farmer. Her works include: 'Aunt Belindy's Point of View'; 'The Doom of the Holy City'; 'A Story Book of Science'; 'A Knight of Faith'; 'Short History of the French Revolution'; 'Girls' Book of Famous Queens'; 'What America Owes to Women'; etc.

Farmer, Moses Gerrish, American electrician; b. Boscawen, N. H., 9 Feb. 1820; d Chicago, Ill., 25 May 1893. He was graduated at Dartmouth College in 1844. He invented several electro-motors, one of which he used in his workshop to drive a lathe, and another on a miniature railway. On this railway he transported by electricity the first passengers ever so carried in the United States. In 1847 he moved to Framingham, Mass., and invented the telegraph fire alarm. In 1865 he invented a thermo-electric battery and also built the first dynamo, and in 1880 patented an automatic elec-

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tric light system. Besides these inventions he brought to light and perfected many others of general utility.

Farmer, Richard, English Shakespearian scholar: b. Leicester 28 Aug. 1735; d. Cambridge, England, 8 Sept. 1797. In 1767 he published his 'Essay on the Learning of Shakespeare,' which passed through several subsequent editions. In it he showed that Shakespeare's knowledge of classical subjects was entirely obtained through translations, which he often followed very closely. He was appointed master of Emmanuel College, Cambridge, in 1775, and was a prebendary of Canterbury 1782–8, when he was appointed to a residentiary prebend in St. Paul's, London.

Farmers' Alliance, a national organization for improving agricultural conditions, advancing social life, securing favorable legislation, etc.; at first non-political, then political, then non-political again. Originating as a State body in Texas about 1876, it coalesced in 1887 with similar State bodies into a national one; and in 1889 joined the Knights of Labor in a common political party called the National Farmers' Alliance and Industrial Union, with a platform demanding more greenbacks, unlimited free coinage of silver, no national banks, anti-speculation laws, and government ownership of all transportation lines. The southern branch added a demand for government loans at low rates, and sub-treasuries to buy and store farm products. In the West in 1890 the party put up its own candidates; in the South it adopted and dictated the Democratic; it carried the Kansas and Nebraska legislatures, held the balance in Illinois, Minnesota, and South Dakota, and elected nine national representatives, and one senator each from South Carolina (nominally Democrat), Kansas, and South Dakota. In 1892 it fused with others and called itself the People's Party (q.v.), and nominated for President James B. Weaver, who received over 1,000,000 votes; but the southern branch declined to change its political affiliations, and seceded, the Alliance proper going out of politics again.

Farmers' Institutes, gatherings of farmers held annually in the various States, sometimes under the direct management of the agricultural colleges and sometimes controlled by other State officers. The object of these institutes is in great part the bringing together of the workers in agricultural science and the practical farmers, for the discussion of questions of mutual interest. The latest agricultural theories are presented and discussed and compared with the result of practical tests and long experience. The development of farmers' institutes has been chiefly due to the impetus given to the agricultural interests of the country by the Morrill Land Grant Act of 1862; yet they are to some extent an outgrowth from agricultural organizations existing previous to that date. These gatherings are held regularly in over 40 States. In 1899 over 2,000 institutes were held in this country, and the special appropriations for this purpose aggregated over $140,000, not including $30,000 funds estimated as expended from other sources. Pennsylvania and New York lead in the number of institutes, each holding 300 or more annually. In Wisconsin the institutes, numbering 120, are part of the university course in agriculture. Michigan has 200, attended by 120,000 farmers. In Ohio, 88 counties hold institutes. The meetings are generally in the winter when the farmers are free to attend them. The morning sessions are principally given to addresses with discussions, question-box methods, etc., and in the evenings there are popular lectures.

Farmers so frequently demand on the part of institute workers a wide range of scientific and practical knowledge, and the latest information regarding agricultural progress throughout the world, that it is impossible to meet the demand made on agricultural colleges and experiment stations in this direction. Under different names, meetings of farmers in many respects similar to those in the United States are held in other countries. In some parts of Europe, teaching of farmers by itinerant instructors is very thoroughly organized. See AGRICULTURE; AGRICULTURE, DEPARTMENT OF; AGRICULTURAL EXPERIMENT STATION; COLLEGES, LAND GRANT.

Farmers' National Congress, an organization having for its object the advancement of the agricultural interests of the Union, and composed of the same number of delegates from each State (or Territory) as the latter is entitled to in its representation in the United States Congress. The delegates are appointed by the governors of their respective States or by some other State official. All heads of State bureaus of agriculture are considered members, and one representative from each agricultural college.

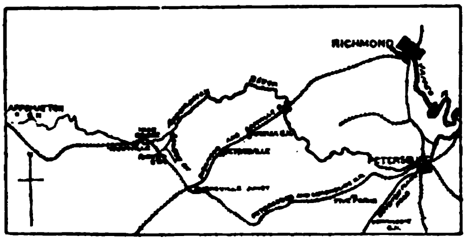
Farming. See AGRICULTURE; AGRICULTURAL CHEMISTRY; DAIRYING; DAIRY CATTLE; etc.

Farmington, Maine, town, county-seat of Franklin County, on the Sandy River and the Maine Cent. and Sandy River R.R.'s; 30 miles northwest of Augusta, on a direct route from the south to Rangeley Lakes. It is a business and educational centre, and has several banks, hotels, a courthouse, a weekly paper, and some manufactories. The town includes several villages, of which Farmington Village (incorporated) is chief. Farmington Academy (1807) was succeeded in 1863 by a State normal school, which has graduated over 1,300 teachers. The Abbott Family School for Boys (1844) opened in 1903 with new buildings. Cutler Memorial Library (1903) is a model granite building. Here for years lived the author Jacob Abbott (q.v.); John S. C. Abbott (q.v.), was once a pastor here; and this is the birthplace of Lillian Norton (Mme. Zoltan Dôme), the prima donna, known as Madame Nordica. Pop. (1910) 3,210.

Farmington, Mo., city, county-seat of Saint François County; about 25 miles from the nearest point on the Mississippi. It is two miles from a railroad station (De Lassus). It is the site of the Farmington Baptist College, Elwood Seminary for Girls, and Carleton Institute. Its manufactures are flour, lumber, wagons, carriages, agricultural and mining implements. There are lead-mines near. Pop. (1910) 2,613.

Farmville, Va., town, county-seat of Prince Edward County; about 40 miles southeast of Lynchburg; on the Appomattox River, and the Norfolk & W. R.R. Here is the State Female Normal School. Farmville has a large manufacture of tobacco. Pop. (1910) 2,971.

Farmville and High Bridge, Engagements at (and THE SURRENDER OF THE ARMY OF NORTHERN VIRGINIA AT APPOMATTOX COURT-HOUSE). Farmville, on the south bank of the Appomattox, 70 miles southwest of Richmond, is noted as the place where Gen. Grant opened his correspondence with Gen. Lee which led to the surrender at Appomattox. After the battle of Five Forks (1 April 1865) and the successful assault on the Petersburg lines (2 April), Lee retreated and Grant pursued. Sheridan, with his cavalry and the Fifth corps, 3 April, pushed for the Danville railroad, keeping south of the Appomattox, followed by the Second and Sixth corps in the direction of Amelia Court-house, while Gen. Ord with the Twenty-fourth corps and a division of the Twenty-fifth, moved along the South-side railroad for Burkesville. On 4 April Sheridan struck the Danville road near Jetersville, and learned that Lee was at Amelia Court-house, eight miles northeast. He immediately entrenched the Fifth corps and awaited the arrival of Gen. Meade with the Second and Sixth corps. Meade found the roads so obstructed with Sheridan's cavalry that he did not get up until the afternoon of 5 April. Ord reached Burkesville on the evening of the 5th. He had been directed by Grant to cut the bridges in Lee's front, to intercept his movements toward Danville and Lynchburg, and await orders at Burkesville. To cut the High Bridge, four miles east of Farmville, Ord, before daybreak of the 6th, sent two small infantry regiments (54th Pennsylvania and 123d Ohio), and 80 officers and men of the 4th Massachusetts cavalry, all under command of Col. Francis Washburn, with orders to push rapidly for the bridge and burn it. After Washburn had gone, Ord sent Gen. Theodore Read, his chief-of-staff, with a small party to overtake him and reconnoitre well before moving up to the bridge. Soon after Read had gone, Ord received a despatch from Sheridan that Lee was moving west of Jetersville and making apparently for Burkesville, upon which he put his command in position to meet him and sent an officer to caution Read that Lee's army was in his rear and that he must return by pressing on, crossing the Appomattox, and going around by Prince Edward Court-house. This last officer was driven back by Lee's cavalry. Read overtook Washburn, took the cavalry into Farmville, examined the country, returned to the infantry and pushing on, was within two miles of High Bridge, when about noon, he ran into Lee's advance, Rosser's and Munford's divisions of cavalry. Read and Washburn drew up the little band of cavalry and 500 infantry and began one of the most gallant fights of the Civil War. Again and again they led the cavalry in successive charges. Read and Washburn fell mortally wounded, and at last not an officer of the cavalry remained alive or unwounded, to lead the men, and the entire command, cavalry and infantry, was enveloped and surrendered.



At 6 A.M. 6 April, the Second, Fifth, and Sixth corps moved from Jetersville up the line of the Danville road toward Amelia Court-house, where it was hoped to intercept Lee, but during the night Lee had moved west, and when this was discovered, after a march of four miles, the advance on Amelia Court-house was suspended and the three corps marched westward parallel to Lee's line of retreat and endeavoring to head him off or bring him to a stand. The Second corps came up to Gordon's corps at Flat Creek and was for a time checked but, fording the creek, drove Gordon off and followed him to Sailor's Creek, where he made a stand, but was again driven with a loss of 13 colors, three guns, several hundred prisoners, and more than 200 wagons. During the day the Second corps had taken about 1,700 prisoners, four guns, and more than 300 wagons and ambulances. Its loss was about 400 men. While the Second corps was thus engaged, the Sixth corps on its left, with the cavalry divisions of Crook and Merritt had overtaken and attacked the commands of Ewell and Anderson on Sailor's Creek, routed them with a severe loss in killed and wounded, and took many thousand prisoners, among them six general officers, including Gen. Ewell. The Confederates continued their retreat. Longstreet with the divisions of Field, Heth, and Wilcox marched to Farmville, crossed to the north bank of the Appomattox and, on the morning of the 7th, began to move out on the road passing through Appomattox Court-house to Lynchburg. Fitz Hugh Lee with all his cavalry followed Longstreet. Gen. Gordon with the other half of Lee's army, crossed at High Bridge. On the morning of the 7th the Union army continued the pursuit, the cavalry, with the exception of one division, and the Fifth corps moving by Prince Edward Court-house; Ord, with his command, the Sixth corps and Crook's cavalry division on Farmville; the Second corps by the High Bridge road. With great difficulty Crook's cavalry waded the river above Farmville, and Gregg's brigade in moving out was fiercely assailed by Fitz Hugh Lee and driven back across the river, Gregg and many of his men being captured. Meanwhile Ord and the Sixth corps had come up to find the bridges destroyed, the water too deep for fording, and Lee's army in plain view on the opposite bank, drawn up for battle. The Second corps, pursuing Gordon, came to High Bridge just as Gordon's corps and Mahone's division had crossed and set fire to it and the wagon road bridge below it. Barlow, whose division was in advance, threw forward his head of column, which seized the wagon road bridge, extinguished the fire, and moved across, Mahone's division after some sharp skirmishing, retiring in a northwest direction, Gordon's corps moving along the railroad toward Farmville. Barlow followed Gordon, while Humphreys led Miles' and De Trobriand's divisions after Mahone and at 1 P.M. came up to Lee's army in an entrenched position, its left four miles from Farmville, on the crest of a long slope of open ground, covering the roads to Lynch-

burg. Poague's 16 guns opened on him, he threw forward skirmishers, and an unsuccessful attempt was made to take the position in flank. Barlow was sent for but did not get up until sunset. Meanwhile Miles saw an opening and attacked with part of a brigade and was repulsed with considerable loss. Barlow, who had followed Gordon, attacked him and succeeded in cutting off a large train of wagons, which he destroyed, and then rejoined his corps, which bivouacked within 100 yards of Lee's position. The loss of the Second corps during the day was 571, and it had captured 19 guns, many wagons, and had held Lee from continuing his retreat, until such time as Sheridan and Ord were fast gaining his line of escape.

At 5 P.M. Gen. Grant, from his headquarters at Farmville, wrote Gen. Lee asking the surrender of his army. This was sent through the Second corps lines at half past eight, and within an hour Lee replied, asking the terms that would be offered on condition of his surrender. During the night Lee retreated, Gordon leading and Longstreet bringing up the rear. The Second and Sixth corps followed Longstreet closely, and Sheridan, with his cavalry, followed by the Fifth corps and Ord's command, marched on the south side of the Appomattox, captured at Appomattox Station four trains of cars loaded with supplies for Lee's army, 25 guns, and a large park of wagons, and drove Lee's advance forces back to Appomattox Court-house. On the morning of 9 April Sheridan advanced but his cavalry was being pushed back just as Ord, who had marched all night, had formed in his rear, and the Army of Northern Virginia had made its last effort. Sheridan and Ord were in its front; the Second and Sixth corps were close on its rear, negotiations were in progress, hostilities were suspended and about 3 o'clock in the afternoon, 9 April, the terms of surrender were agreed upon, and the War of the Rebellion was practically ended.

Consult: ‘Battles and Leaders of the Civil War’ (Vol. IV.); Gen. Grant's ‘Personal Memoirs’ (Vol. II.); Gen. Sheridan's ‘Personal Memoirs’ (Vol. II.); Humphreys', ‘The Virginia Campaign of 1864–5’; ‘Official Records’ (Vol. XLVI.); Powell, ‘History of the Fifth Army Corps’; Walker, ‘History of the Second Army Corps.’

E. A. CARMAN.

Farne, fărn, or **Ferne** (fėrn) **Islands,** or **The Staples,** a group of islands in the North Sea, belonging to England; about two miles from Bamborough. Saint Cuthbert lived for some years on the largest island of the group and died here; ruins of the old abbey of which he was prior, of the ancient chapel, and of a peal tower still exist. These islands have been the scene of several disastrous shipwrecks, one of which, that of the Forfairshire steamer (1838), occasioned a display of remarkable heroism by Grace Darling, daughter of the keeper of one of the lighthouses. Another steamer, the Pegasus, going from Leith to Hull, was lost here in 1843 and 60 individuals perished. There are three lighthouses on the islands.

Farnese, Alessandro, ă-les-sän'drō fär-nā'-sĕ, Italian general: b. Rome 1547; d. Arras, France, 3 Dec. 1592. He served his first campaign under Don John of Austria, and distinguished himself in the battle of Lepanto in 1571. In 1577 Philip II. ordered him to lead back the Spanish troops, which Don John had been obliged to dismiss from Flanders; and Don John dying that year, Alessandro was made governor. He recovered Maestricht and several other cities, and succeeded in reconciling the Catholic part of the insurgents to the Spanish government. The Protestants, however, formed the Union of Utrecht (1579), and called in the Duke of Anjou, a brother of Henry III. of France, to defend them. He appeared at the head of an army of 25,000 men; but Alessandro was constantly successful.

Farnese, Alessandro. See PAUL III., POPE.

Farnese Bacchus, a torso of Bacchus, an example of Greek sculpture of the 4th century B.C. It is in the National Museum at Naples.

Farnese Bull, a group of statuary representing Dirce, whom the sons of Antiope, her slave, are preparing to bind to the horns of the wild bull, which Dirce had intended to be the instrument of her vengeance upon Antiope. This is the most elaborate and dramatic, almost melodramatic, group to be found among the monuments of Greek art. It is the work of the vivacious Rhodian school, executed by Apollonius and Tyriscus. Having been transported to Rome, it was lost sight of for some hundreds of years. It was dug up in excavating the baths of Caracalla and in 1786 sent from the Palazzo Farnese to the National Museum at Naples.

Farnese, Elizabeth. See ELIZABETH FARNESE.

Farnese Hercules, a colossal statue, dating from the age of Hadrian, supposed to be a marble copy by Glyeon of a bronze by Lysippus. It is an example of the turgidity and exaggeration which marked the decadence of Greek sculpture, wherein passion for scientific display of triumphs over all sense of ideal beauty, proportion and repose. Hercules is represented as leaning on his club, holding in one hand the Hesperidian fruit. The statue was dug up in the baths of Caracalla and passed through the Farnese family to the museum at Naples.

Farnese Homer, a bust of the Father of Poetry, which evidently belongs to the later period of Greek sculpture. It is in the National Museum at Naples.

Farnese Juno, a colossal head, a copy of a bronze original, representing Hera, “the Queen of Gods.” It is in the National Museum, Naples.

Farnese, Minerva, The, an archaic statue of Athene, found at Velletri, at the foot of the Alban Hills, Italy. It is supposed to be a copy of the chryselephantine statue of Phidias, which stood in the main shrine of the Parthenon.

Farnham, färn'ạm, **Eliza Woodson Burhaus,** American philanthropist: b. Rensselaerville, N. Y., 17 Nov. 1815; d. New York 15 Dec. 1864. She traveled extensively; returned to New York in 1841; visited the State prison and lectured to the women convicts; and was matron of the Sing Sing State Prison for four years. She was the author of: ‘California, Indoors and Out’; ‘My Early Days’ (1859); and ‘Woman and Her Era’ (1864), her most finished work.

Farnham, Ralph, American soldier: b. Lebanon, Me., 1756; d. Acton, Me., 1861. He was the last survivor of the Battle of Bunker

Hill, and the first settler in Acton. A public concert was given in his honor in Boston, October 1860, at which he was present. He was 104 years, 9 months, and 19 days old when he died.

Farnham, Roswell, American soldier and lawyer: b. Boston, Mass., 23 July 1827. He was graduated at the University of Vermont in 1849, admitted to the Orange County bar in 1857, and served as State attorney 1859–61. During the Civil War he was successively lieutenant of the 1st Vermont Regiment; provost-marshal of Newport News, Va.; and lieutenant-colonel of the 12th Vermont Regiment from enlistment to disbandment. He was governor of Vermont 1880–2.

Farnham, or **West Farnham,** Canada, in the province of Quebec; on the Yamaska River, the Canadian P., and the C. V. R.R.'s; about 40 miles southeast of Montreal. The chief manufactures are beet-root sugar, flour, and dairy products. Pop. 3,000.

Farnworth, färn'wėrth, England, a market town in Lancashire, three miles southeast of Bolton. It has a grammar school founded in 1715, and among its industrial establishments are paper-mills, iron foundries, cotton-mills, collieries, brick works, etc. The Bolton waterworks are at Farnworth. Pop. 25,927.

Faro, fä'rō, Portugal, a seaport on the south coast, capital of the district of Faro, on a bay protected by islands. It contains an old castle surrounded by Moorish fortifications. The town is well built, and has a fine square, a cathedral, and a number of good schools. There is a considerable trade, chiefly in oranges, dried fruits, oil, cork, wine, etc. Deposits of antimony and of salt are in the neighborhood. In 1722 and 1755 the city suffered great damage and loss of life from earthquakes.

Faro, fä'rō, is a gambling game pure and simple. A pack of cards is fastened in a clip, face downward, so that one card at a time can be withdrawn. The spectators, before it is turned face upward, bet, some that it will be one kind of card in value, such as ace, king, queen, or jack; others that it will have this or that number of «pips» on it; others that it will be red or black. When all have been drawn but the last three the betting is restricted as to their order of appearance. Faro was introduced into France by the Venetian ambassador in 1674, in a form like bassette; but so many nobles were ruined by this game that Louis XIV. made a law against it. To elude this law it was called *pour et contre,* which gave rise to new prohibitions, to evade which the name Pharaoh was adopted. Faro is not a common game in the United States, although it is played at the large gambling houses in New York, Chicago, Long Branch, N. J.; Saratoga, N. Y., and on the Pacific coast. See GAMBLING.

Faroe, fä'rō, or **Faröer Islands** (that is «Sheep Islands»), a group of islands in the Northern Ocean, lying between lat. 61° 20' and 62° 25' N., about 280 miles southeast of Iceland, and about 190 miles northwest of the Shetland Islands; area 514 square miles. They belong to Denmark, and consist of about 20 islands, of which 17 are inhabited. The largest islands are Strömö (144 square miles), Osterö, Sandö, Suderö, and Vaagö. The islands generally present steep and lofty precipices to the sea; the surface rises toward the interior, Slattaratinde in Osterö being 2,894 feet high, while a pinnacle called the Witch's Finger is said to be 3,000 feet. The climate is milder than the latitude might indicate, but the weather is very variable; the annual rainfall is about 70 inches. Sheep and horses can winter in the open air. The soil is generally thin; barley is the only cereal that comes to maturity; turnips and potatoes thrive well. There are no trees, but plenty of excellent turf, and also coal. The wealth of the inhabitants is chiefly derived from fishing and the feeding of sheep. The feathers of sea-fowl form an important article of trade. Some horses and cattle are kept; the former are small, but strong and hardy. Thorshavn, in Strömö, is the seat of government, and the only town. These islands have belonged to Denmark since 1380. The inhabitants are Norse, and speak a Norse dialect in which there are a number of old ballads extant; the official language is Danish. They have a home government and are also represented in the Danish Parliament by two representatives elected by the people. Pop. about 15,000. Consult: Jeaffreson, 'The Faroe Islands.'

Farquhar, Anna, American author (MARGARET ALLSTON), who became Anna Farquhar Bergengren on marrying, 26 Jan. 1900, Ralph Bergengren.

Farquhar, fär'kwär, **George,** Irish dramatist: b. Londonderry 1678; d. April 1707. About 1606–8 he went to London, where he commenced writing for the stage. His first production was 'Love and a Bottle,' performed with great success in 1699. In 1700 he added to his reputation by his comedy of 'The Constant Couple,' in which, under the character of Sir Harry Wildair, he exhibited a lively picture of the foppish fine gentleman of the end of the 17th century. In 1701 appeared 'Sir Harry Wildair,' a sequel to the former; and the following year he published a volume of 'Miscellanies.' 'The Inconstant, or the Way to Win Him,' appeared in 1703, and is among those which have kept possession of the stage. In 1706 appeared 'The Recruiting Officer,' one of his most popular plays; and this was succeeded by 'The Beaux' Stratagem,' which is reckoned his masterpiece. It is no mean testimony of the dramatic talents of Farquhar that three of his plays are still favorites with the public. His wit is genuine and spontaneous, and his characters are admirably supported, and drawn from nature. His plots excel in the arrangement of incidents and in unity of action. The libertinism of language and sentiment which his works exhibit cannot be defended; but it was the vice of the age rather than the writer, who was much less culpable in this respect than Dryden or Wycherley.

Farquhar, Norman von Heldrich, American naval officer: b. Pottsville, Pa., 11 April 1840; d. 3 July 1907. He graduated at Annapolis in 1859; was acting master in the African squadron engaged in the suppression of the slave trade 1859–61; and, during the Civil War, served in the North Atlantic blockading squadron. He commanded the Trenton when she was wrecked at Apia, Samoa, in 1889; became chief of the Bureau of Yards and Docks in 1890; and commandant of the Norfolk navy yard. He became rear-admiral in 1899, and retired 1902.

Farquharson, James, Scottish scientific writer: b. Coull, Aberdeenshire, 1781; d. 3 Dec. 1843. After obtaining his elementary education in the parish school at Coull he entered King's College, Aberdeen, whence he was graduated M.A. in 1798, receiving an appointment as schoolmaster that year at Alford. He later studied theology and was licensed to preach, but devoted all his leisure moments to the study of meteorology, botany, chemistry, zoology, and kindred branches. He wrote many papers for scientific journals, the most important of which are those on the aurora borealis, contributed to the 'Philosophical Transactions' of the Royal Society, the 'Edinburgh Philosophical Journal' (1823), and 'Philosophical Transactions' (1829–30). In 1836 he wrote for the last-named paper a remarkable treatise on the formation of ice at the bottom of running water. He also wrote: 'On the Nature and Localities of Hoar Frost' for the 'Transactions' of the Highland and Agricultural Society of Scotland for 1840. Among his religious publications are: 'On the Form of the Ark of Noah' (1831); 'A New Illustration of the Latter Part of Daniel's Last Vision and Prophecy' (1838); etc.

Farquharson, Joseph, Scottish painter: b. 1842. He inherited his love for painting from his father, who himself was an artist of some note. At the age of 13 he had become proficient enough in his art to send a picture, 'A Study from Nature,' to the exhibition of the Royal Scottish Academy at Edinburgh. When 16 years of age he entered the Board of Manufacturers School, Edinburgh, to pursue his studies under Hodder, and from there passed into the Life School. From 1859 to 1881 his pictures appeared in the periodical collections of the Royal Scottish Academy without a break. In 1880 he determined to perfect himself by a visit to the Parisian ateliers, and for several winters worked there under Carolus Duran. In 1900 he was elected an associate of the Royal Academy. Among his most noted pictures are: 'The Critics' (1866); 'Day's Dying Glow' (1873); 'Wonderland' (1879); 'The Babes in the Wood' (1880); 'Joyless Winter Days' (1883); 'Where Next?' (1883); 'The English Vintage' (1884); 'In Cairo' (1886); 'Under the Palm Trees' (1887); 'Summer Days' (1887); 'My Heart's in the Highlands' (1890); 'He Led Them Wandering O'er the Sandy Way' (1891); 'Leaving the Hills' (1892); etc.

Farquharson, Martha. See FINLEY, MARTHA.

Farr, Samuel, an eminent Scottish physician: b. Taunton, Somersetshire, in 1741; d. Upcott, near Taunton, 11 March 1795. He received his early education at the dissenting academy at Warrington, later pursued his medical studies at Edinburgh, and completed his course at Leyden University, whence he was graduated M.D. in 1765. He then settled in his native town, where he soon acquired a lucrative practice. It is for his medical writings that he is chiefly noted, his works showing the results of much original observation and extensive experience, and the majority of them are considered authorities in that line. They are 'An Essay on the Medical Virtues of Acids' (London 1769); 'A Philosophical Inquiry into the Nature, Origin, and Extent of Animal Motion' (London 1771); 'Aphorism de Marasmo, ex summis medicis collecti' (1772); 'Inquiry into the Propriety of Blood-letting in Consumption' (1775); 'The History of Epidemics by Hippocrates in seven books translated into English from the Greek, with Notes and Observations' (1781); 'A Preliminary Discourse on the Nature and Cure of Infection' (London 1781); 'Elements of Medical Jurisprudence' (London 1788); 'On the Use of Cantharides in Dropsical Complaints' ('Memoirs Medical,' ii. 132, 1789); etc.

Farr, William, English statistician: b. Kenley, Shropshire, 30 Nov. 1807; d. 14 April 1883. In 1837 he contributed an important article on vital statistics to Macculloch's 'Account of the British Empire,' and in the following year was appointed compiler of abstracts in the registrar-general's office. From 1839 he was connected with the Statistical Society, of which he was president 1871–2, and in 1885 there appeared a collection of Farr's statistical works entitled 'Vital Statistics,' comprising six parts treating respectively of population, marriages, births, deaths, life-tables, and miscellaneous matters.

Farragut, făr'ạ-gut, **David Glasgow,** American naval officer: b. Campbell's Station, Tenn., 5 July 1801; d. Portsmouth, N. H., 14 Aug. 1870. His mother, Elizabeth Shine, sprang from the Scottish family of MacIven. His father, George Farragut, was born on the island of Minorca in 1755. He was descended of an ancient and noble Spanish family, originally of Aragon but for 400 years of the Balearic Islands, where they held many positions of trust and responsibility. George Farragut came to America in 1776, espoused the colonial cause, and served creditably in the army, where he is alleged to have saved the life of Col. Washington at the battle of the Cowpens, and was afterward a sailing master in the navy.

Commander David Porter had been a shipmate of George Farragut. The latter had been transferred to the naval station at New Orleans and had bought a plantation on the Pascagoula River, where Porter visited him. The commander took a great fancy to David and with his father's consent — his mother being dead — practically adopted him with the intent of putting him in the navy.

David Farragut was warranted midshipman on 17 Dec. 1810, being less than 9½ years old. He had been nearly two years at school in Chester, Pa., when in August 1811 he was ordered to the frigate Essex, Porter's ship. He was in all the minor engagements before the famous Essex sailed on her unprecedented cruise to the Pacific. Such was the scarcity of officers that in June 1813 the little midshipman, not quite 12, was made prize master of the whaler Barclay. The English captain was sent along as adviser. He attempted to take things into his own hands, but Farragut, with a coolness and courage remarkable, retained command and brought his vessel into port.

He was slightly wounded in the terrific battle in which the Essex was destroyed by the Phœbe and Cherub. During a crisis in the action Porter actually sent this stripling to shoot a seaman who was reputed to be flinching from his gun. Farragut would have carried out his captain's orders if he had been able to find the man. In writing his report to the secretary of the navy Porter was compelled to say that Farragut was too young for the promotion he had earned by his gallant conduct.

After the war he remained in the service, taking advantage of such educational opportunities as were afforded him between and during his cruises. In the spring of 1819 he was appointed acting lieutenant of the brig Shark, being then 18 years of age. In 1823 cruised in the West Indies against Cuban pirates. He was married in September 1823 to Miss Susan C. Marchant of Norfolk. He was commissioned lieutenant 23 Jan. 1825. In 1828 witnessed the capture of San Juan de Ulloa by the French while in command of the Erie. Mrs. Farragut died 17 Dec. 1840, leaving no children. He was commissioned commander 9 Sept. 1841 and in December 1843 married Miss Virginia Loyall of Norfolk; by her had one son, who survives him. During the Mexican War commanded the Saratoga. Had no opportunity for distinction and became involved in a dispute with Commodore M. C. Perry, commanding naval forces. August 1854 established Mare Island Navy Yard, Cal.; commissioned captain 14 Sept. 1855. In general, his service between 1815 and 1861 was arduous and exacting and was diligently and successfully performed. His devotion to Union sentiment forced him to leave Norfolk in April 1861. Removed his family to Hastings-on-Hudson, N. Y., and at first vainly sought orders to active service.

In January 1862 was given command of the Western Gulf Blockading Squadron and ordered to open the mouth of the Mississippi River by taking New Orleans, which was defended by two forts, a river fleet of 17 vessels, including fireships and rams. The way up the river was barred by a boom. Farragut had a superb fleet of 6 heavy ships, 16 gunboats, 21 mortar vessels, and 5 smaller craft.

On 24 April 1862 the boom was broken, the forts passed, and the river defense fleet annihilated after a sanguinary and desperate battle. New Orleans surrendered four days later. The daring of the attack was only equaled by the skill with which it had been planned. Three vessels of the fleet failed to pass the forts. The Varuna was sunk, the flagship Hartford grounded in the midst of the action and was set on fire by a fireship pushed against her by the Confederate ram. She was got off in safety, however. As Farragut said, «They had a rough time.»

Ordered to clear the Mississippi, in June 1862, Farragut passed the batteries at Vicksburg, but there being no land force there to co-operate with him he repassed the batteries and returned to New Orleans. Was commissioned rear admiral 16 July 1862, the first in the United States service. On 14 March 1863 attempted to take his fleet past the Confederate works at Port Hudson. Grant was then operating against Vicksburg. Farragut perceived that if he could get ships below Vicksburg he could prevent Confederate forces in that city from receiving supplies and re-enforcements from west of the Mississippi. Farragut's conception was strategically sound and brilliant. He boldly endeavored to carry it out.

Still in the Hartford, with a gunboat lashed alongside, he passed the batteries under a terrific fire. None of the other vessels succeeded in getting past. The Mississippi, of which George Dewey was the executive officer, grounded, was set on fire by Confederate shells, and burned to the water's edge. Farragut had only partially succeeded. Still the Hartford and the Albatross patrolled the river and practically cut all communication west of Vicksburg.

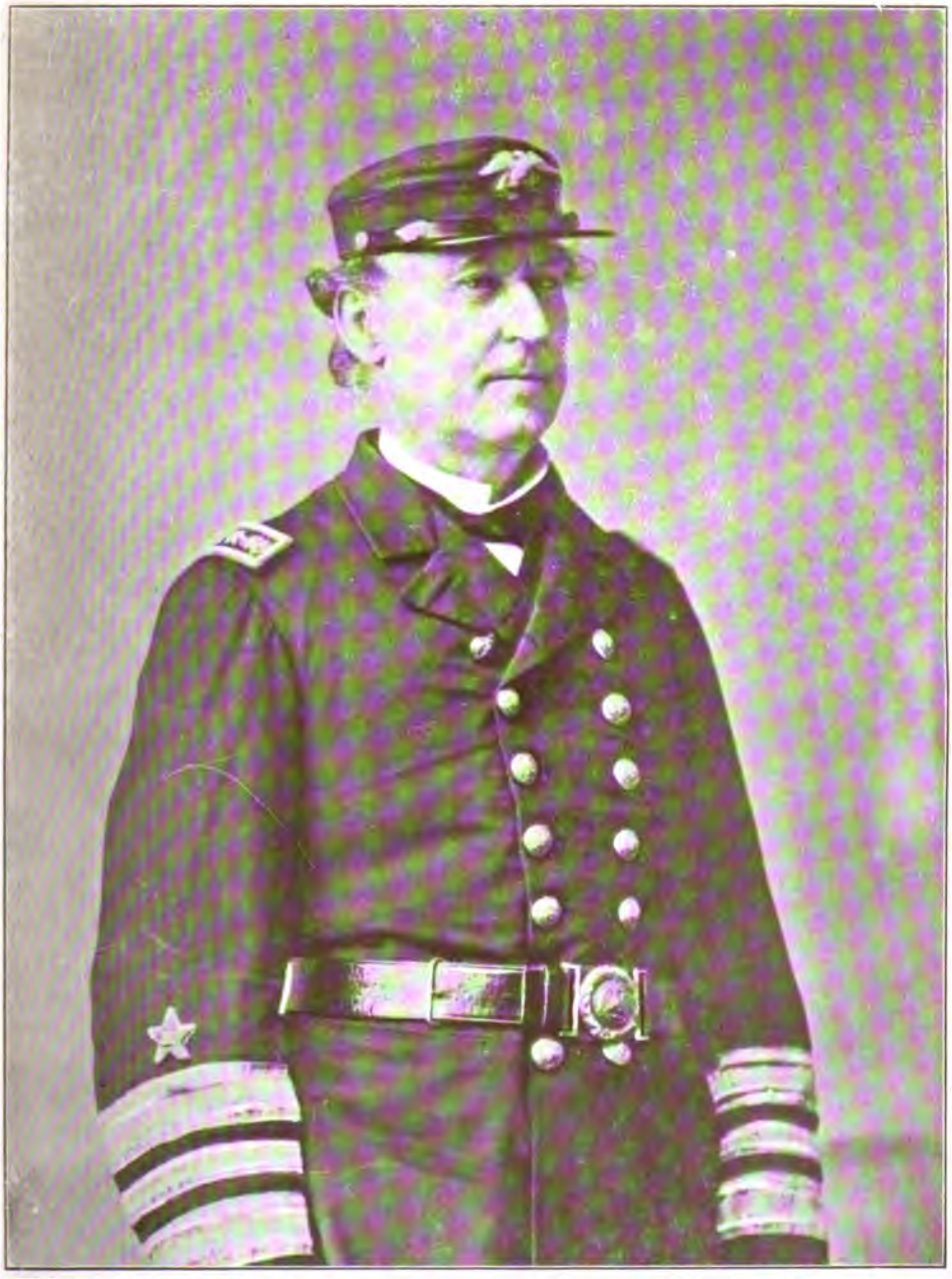
After the fall of Port Hudson he returned to New Orleans and on 1 Aug. 1863 sailed for New York to recuperate his health, impaired by his arduous labors. In January 1864 took command of the naval forces acting against Mobile. On the morning of 5 August entered the bay. The mouth was protected by two formidable forts, Morgan and Gaines. The narrow channel was obstructed by piling and lines of floating torpedoes. Farragut's fleet comprised 30 vessels, of which 8, including the flagship Hartford, were steam sloops-of-war of the first class. There were 4 monitors and 18 gunboats.

He attempted the passage with seven of his heavy sloops, each one lashed to a gunboat on its port side. The four monitors, the Tecumseh leading, were sent ahead, followed by the Brooklyn-Octorara couple, then the Hartford-Metacomet couple, and the other ships in succession. Farragut had ordered the column to pass close under the walls of Fort Morgan, through an opening left free of torpedoes for blockade runners.

At 7.45 A.M. the Tecumseh opened fire. The Confederate batteries did not reply until 20 minutes later. In Mobile Bay lay three gunboats and the ironclad ram Tennessee, Commodore Franklin Buchanan, a match, it was believed for the whole Union fleet. As Farragut approached the ram took position behind the torpedo line. In his eagerness to engage this redoubtable foe Craven on the Tecumseh disobeyed the admiral's order, and instead of passing through the opening headed for the Tennessee. He struck a torpedo and was blown up just as the Brooklyn got fairly under fire. Striking empty shell boxes thrown overboard from the vessels preceding it was thought she was in danger of torpedoes. She stopped and swung with her head toward the fort where none of her guns bore. The Confederates poured a rain of shot and shell upon her. The Hartford, coming up fast, nearly fouled the Brooklyn. The hesitant ships were bunched and made a target for every Confederate gun. The battle seemed lost.

Farragut, ascertaining that the Brooklyn had stopped for fear of torpedoes, ordered the Hartford to the head of the line, giving utterance to that immortal phrase: «Damn the torpedoes! Go ahead!» The Hartford passed the Brooklyn, narrowly escaping shoals to port and raced up the bay toward the Tennessee. It was now impossible to pass through the designated channel and Farragut drove the Hartford across the torpedo line. The example of the admiral put spirit into the Brooklyn and with the other ships she followed the flag. Fortunately no other torpedoes exploded and the whole fleet successfully passed the forts after a bloody and desperate battle.

The Tennessee had ranged along the Union ships and, immune to their fire, had shelled them at will. As soon as the passage had been made the Union gunboats were cast off from the frigates and the Confederate gunboats were captured or driven to the shelter of Fort Mor-



DAVID GLASGOW FARRAGUT.

gan. At 9 A.M. the Tennessee, with surprising gallantry, came up toward the Middle Ground to engage the Union fleet. To this battle Farragut was nothing loth. By his orders the wooden ships were hurled upon their antagonist. The Monongahela struck her a terrific blow at a right angle. The Lackawanna repeated the ramming tactics. The bows of the wooden ships were stove in to the water line. Both ships were raked by the Tennessee's rifles; their return broadsides doing no damage to the iron plating. The Tennessee made straight for the Hartford, which was bearing down directly upon her, bows on. One or the other ship would have been sunk had not the Tennessee swerved so that the Hartford struck her a glancing blow. The ram was now beset by all the vessels of the Union fleet which could get at her. She was rammed, hammered, and pounded. The monitors with their heavy guns were racking her from stem to stern. In the mêlée the Lackawanna rammed the Hartford, cutting her down to the water's edge. Finding his ship would still float Farragut ordered her again to ram the Tennessee. By this time the ironclad's smokestack had been shot away, the casemate was an inferno, the heavy battering had jammed the port shutters, shot had entered through the ports, not a gun could be fired, steam ran down in the boilers. She could neither fight nor fly, so she surrendered, after one hour of as fierce fighting as ever recorded.

During the passage of the forts Farragut had taken position in the main rigging in order to get above the smoke of the battle and be able to direct the maneuvers of the fleet the better. The quartermaster had passed a lashing around the admiral so that in case he should be wounded and lose his footing he would not fall to the deck.

In the battle Farragut should have led in the Hartford. It was only the urgent representations of his captains that made him take the second place. The battle was nearly lost by the gallant Craven's disobedience of orders and that it was finally won was due to the personal initiative of the admiral himself.

This completed his service during the war. He was 64 years old when he fought the battle of Mobile Bay. His health was quite broken. He was commissioned vice admiral 23 Dec. 1864; admiral 26 July 1866; sailed 28 June 1867 from New York in the steam frigate Franklin for an extended cruise in European waters, where he received such a welcome and was accorded such honors as have been tendered no other American save Gen. Grant. He returned to New York on 10 Nov. 1868, visited the Pacific Coast in the summer of 1869 and died 14 Aug. 1870. He was accorded the honor of a public funeral in New York 30 September, and was buried at Woodlawn Cemetery, Westchester County.

Farragut was a rather small man with broad shoulders and a well-knit, vigorous frame. His face was long with a broad high forehead and an aquiline nose. His complexion was dark and his eyes brown. He was a cultivated gentleman of the highest type, a most accomplished officer, a lion in bravery, a woman in gentleness. He was a simple-minded Christian of a high and humble type, a communicant of the Protestant Episcopal Church. A statue of him by Saint Gaudens stands in Madison Square, New York. One by Kitson in Boston; another by Vinnie Ream Hoxie in Washington. In the Church of the Incarnation, New York, is a mural tablet with a bas-relief of the admiral by Launt Thompson. Consult: 'Life and Letters,' by his son; Mahan, 'Admiral Farragut'; Barnes, 'Admiral Farragut'; Parker, 'Battle of Mobile Bay'; Brady, 'The Southerners.'

CYRUS TOWNSEND BRADY.

Farrakhabad. See FARUKHABAD.

Farrant, făr'ant, **Richard,** English composer: b. 1530; d. Windsor 1585. Very little is known of his history. He was a gentleman of the chapel royal for some time up till 1564, when he became organist and choir-master of St. George's, Windsor, but in 1569 he was again appointed to the chapel royal. His music is ecclesiastical, and is distinguished by purity, simplicity, tenderness, and elevation of tone. The anthems 'Call to Remembrance,' and 'Hide not Thou Thy Face,' composed by him, are well known and highly esteemed by lovers of good music. The exquisitely beautiful anthem, 'Lord, for Thy Tender Mercies' Sake,' has been attributed to him, but also to Thomas Tallis and John Hilton.

Farrar, Eliza Ware Rotch, American writer: b. Flanders, Belgium, 1791; d. Springfield, Mass., 22 April 1870. She married Prof. John Farrar of Harvard University. Her works include: 'The Children's Robinson Crusoe'; 'The Story of Lafayette'; 'The Youth's Love-Letters'; 'Congo in Search of His Master' (1854); and 'Recollections of Seventy Years' (1865).

Farrar, Frederick William, English clergyman and author: b. Bombay 7 Aug. 1831; d. London 22 March 1903. He studied at King William's College, Isle of Man, and Trinity College, Cambridge, having gained one of the college scholarships. He was ordained deacon in the Established Church 1854 and priest in 1857, and for 16 years was an assistant master at Harrow. From 1871 till 1876 he was head master of Marlborough College, resigning on his appointment as a canon of Westminster and rector of St. Margaret's. In 1883 he was appointed Archdeacon of Westminster, and in 1895 became Dean of Canterbury. From 1890 till 1895 he acted as chaplain to the House of Commons. Besides identifying himself with various social and philanthropic movements, he published many popular and able works of various kinds. In fiction he published: 'Eric, or Little by Little' (1858); 'Julian Home: a Tale of College Life' (1859); 'St. Winifred's'; 'Gathering Clouds: a Tale of the Days of St. Chrysostom' (1896); in philology: 'Origin of Language' (1860); 'Families of Speech' (1870); 'Language and Languages' (1878); etc.; and on theological and religious subjects: 'Seekers After God' (1869); 'The Witness of History to Christ' (1871); 'Life of Christ' (1874), a work which achieved extraordinary popularity; 'Life of St. Paul' (1879), also highly popular; 'Early Days of Christianity' (1882); 'History of Interpretation' (1885); 'Eternal Hope' (1888); 'Lives of the Fathers' (1889), a popular work; 'The Bible: Its Meaning and Supremacy' (1897); 'The Herods' (1897); 'The Life of Lives' (1899); 'Temperance Reform’; ‘Texts Explained’ (1899). In August 1885, he came to the United States, thereby realizing what he said had been one of the desires of his life. He remained in this country until the beginning of December, traveling, visiting friends and lecturing. He was a man of great eloquence, tremendous energy and was greatly beloved by all ranks, high as well as low. His most intimate American friend was Phillips Brooks.

Farrer, fär'ėr, **Henry,** American artist: b. London, England, 23 March 1844. He was the son of an English miniature painter, Thomas Farrer (1770–1850), and came to New York in 1863. He has painted largely in water colors but is widely known as an etcher also.

Farriery. See Veterinary Art.

Farrington, Oliver Cummings, American geologist: b. Brewer, Maine, 9 Oct. 1864. He was graduated at the University of Maine in 1881; became lecturer on mineralogy in the University of Chicago in 1894, and curator of geology at the Field Columbian Museum in the same year. He has published: ‘Meteorites’; and ‘The Volcanoes of Mexico.’

Fars, färs, or **Farsistan,** fär-sis-tän' (ancient Persis), a province in the southwest of Persia, about 300 miles long by 250 miles broad. Its chief rivers are the Bandamir, the Sefid-rud, and the Mand; and it has several salt lakes, of which the largest is that of Bakhtegan. The most important products are grain, rice, fruit, wine, oil, cotton, tobacco, silk, cochineal, and attar of roses. The manufactures include woolen, silk, and cotton goods; and in these and other articles an active trade is carried on, chiefly with India. Many ancient ruins are scattered over the province. The capital is Shiraz, and the chief port is Bushire or Abushehr. About 30 miles north of Shiraz are the ruins of Persepolis, an ancient city. The people of this province are among the best preserved types of the Aryans. Pop. (estimated) 1,700,000.

Farsan (fär-sän') **Islands,** a group of two larger and several small islands on the east side of the Red Sea. The surface is diversified by hills composed of coral, and occasional valleys and plains. Pearl-fishing is here an important industry.

Farukhabad, fu-rook'ä-bäd, or **Farrakhabad,** fur-ruk-ä-bäd', India: (1) town in India, in a district of the same name in the northwest provinces; about two miles west of the Ganges, 90 miles west-northwest of Lucknow. It forms a single municipality with Fatehgarh, the civil headquarters of the district, situated three miles to the east. Pop. (1901), with cantonment, 67,338. (2) The district of Farukhabad forms part of the Agra division, and lies mainly along the western bank of the Ganges. Area, 1,720 square miles.

Farwell, Charles Benjamin, American merchant and legislator: b. Painted Post, N. Y., 1 July 1823; d. Lake Forest, Ill., 23 Sept. 1903. Having gone in 1838 to Illinois, he was there engaged in farming and government survey work until 1844, when he entered a mercantile career in Chicago. He accumulated a fortune in the dry-goods trade. In 1869 he was a national bank examiner, in 1871–6 and 1881–7 a representative in Congress. From 1887 to 1891 he was United States Senator, having been elected to fill the vacancy caused by the death of Gen. J. A. Logan. He was a figure of some prominence in both State and national politics.

Fasano, fä-sä'nō, **Italy, a town in the** southeast, near the Adriatic; 30 miles southeast of Bari. It is in the midst of an olive district, and there are numerous oil-presses in the town and neighborhood. The chief trade is in oil and wine. The cottages of many of the peasants have been made from the stone taken from old walls. Fasano was at one time a wealthy residential and commercial city. Pop. of the commune, 16,900.

Fasces, fas'ēz (Lat. *fascis,* a bundle), the most ancient insignia of the Roman magistrates, consisting of bundles of rods, usually birch, bound with which was an axe with projecting blade; used as a symbol of authority. The fascis was carried by an attendant known as a lictor. The number of lictors varied according to rank, and for a given dignitary frequently differed at different periods. Fasces were accorded quæstors in the provinces only.

Fascia, in anatomy, an animal tissue, consisting of dense connecting sheets or layers, of the nature of fibrous membrane, close and strong as tendon or ligament. The fascia in the economy of animal anatomy serves the purpose of confining within its proper area, supporting as a sort of fulcrum, separating from one contiguous tissue, or attaching to another, some muscle, part or organ of the body. See the works on ‘Anatomy’ of Quain and Morris, in English; of Gegenbaur and Rauber, in German; and of Testut and Poirier, in French.

In architecture, a flat band, running horizontally across an entablature. The architrave in the Corinthian and Ionic orders is divided into three bands which are called fasciæ; the lowest being called the first fascia, the middle one the second, and the upper one the third. When there are only two fasciæ, they are called the upper and lower. See Column; Entablature.

Fascination (Lat. *fascinare,* “to bewitch”). Various animals, such as toads, hawks, and notably certain varieties of serpents have been popularly invested with the power of controlling by their eyes the movements of intended victims. Such power has never been scientifically demonstrated, and supposed manifestations have generally been explained as paralysis through fear on the part of the victim. For an account of the belief in the evil eye in human beings, see Superstition.

Fascine, fă'sēn (Lat. *fascina,* a bundle of sticks), in fortification, a cylindrical bundle of faggots or brushwood used to form parapets, strengthen ramparts, elevate batteries, prepare temporary field defenses, and the like. They vary in size from 6 to 18 feet in length, 6 to 9 inches in diameter, and are bound with withes. Fascines dipped in pitch or other combustible matter are sometimes used in order to set fire to the enemy's lodgments or other works. In civil engineering fascines are used in making sea and river walls to protect shores subject to washing; or to collect sand, silt, and mud to raise the bottom and gradually form an island, either as a breakwater against inroads, or for purposes of cultivation, as in Holland.

Fasciolaria, a genus of mollusks. See Fusidæ.

Fashion, conventional usage in the matter of certain details of life, especially the changes and modifications of costume in civilized nations; mode or style in dress. Such variations of costume were unknown to most nations of the ancient world, and among the Romans only influenced the accessories of the toilet. The unchanging East is as unchanging in its dress as in everything else, and the fashions to which savage tribes uncompromisingly adhere remain unaltered for long periods. In some remote districts of European countries peasants still dress in the costume brought two or three hundred years ago by the local nobility from court, and the smock-frock of the English agricultural laborer is a relic of Saxon times. (For detailed history of the costumes of different periods, see article on COSTUME, and for certain principles underlying the subject, see DRESS.) Survivals in modern costume may sometimes be traced back to unexpected origins. With regard to the modern evening dress-coat we learn that it owes its peculiarities to its descent from the old-time everyday garment in which a man rode and worked. «The cutting away at the waist had once the reasonable purpose of preventing the coat skirts from getting in the way in riding, while the pair of useless buttons behind the waist are also relics from the times when such buttons really served the purpose of fastening these skirts behind; the curiously cut collar keeps the now misplaced notches made to allow of its being worn turned up or down.» [It is said that the modern cylindrical hat is the indirect descendant of the Puritan steeple-crowned hat, carried across the Atlantic by the Pilgrim Fathers, thence again to France, when Benjamin Franklin and the young Republicans were the height of the fashion, and by the French manipulated into the hat which they have given to all the world.] Certain striking features in vogue at different times in the dress both of men and of women have originated in the lack of bodily symmetry or in other physical defects in various monarchs or other leaders of fashion. Until the 19th century men's clothes were as delicate in color and as rich in material as women's. Pepys records in his diary how he had his wife's gowns cut up into waistcoats for himself. The uniforms of officials or of persons connected with public or special service, the judge's and the clergyman's robe and the student's cap and gown cannot be said to have had their origin in fashion; nor can the indication of political or religious opinions by peculiarities of dress, as among Puritans and Quakers, or as illustrated by colored cockades or other party emblems be called phases of fashion, yet fashion has been sometimes closely connected with political changes. Dress attained its highest point of significance in France during the last half of the 18th century, when it marks unmistakably the various stages of the Revolution. Rousseau's 'Emile and Nouvelle Héloïse' and Goethe's 'Werther' brought sentimentality into fashion; women's hair was dressed in *bandeaux d'amour* or *poufs de sentiment;* and Marie Antoinette and the ladies of her court sought to return to the simplicity of nature by masquerading in the Trianon attired as shepherdesses and milkmaids. The works of Montesquieu and Voltaire had created an admiration for England, and the courtiers of Versailles dressed themselves like English fox-hunting squires, while their wives and daughters got themselves up *á l'Anglaise* in coats with cuffs, collars, and facings, beaver-hats, and cravats. As the political turmoil increased, fashionable attire grew more and more eccentric and multiform, till at last republican institutions triumphed, and the women of France began to clothe themselves as like as possible those of Greece and Rome both in style and scantiness. They discarded costly materials, and shivered through the winter months clad in a few yards of muslin. Men wore a combination of antique and romantic costume invented by the painter David, which was finished off with Hungarian boots. At the present time the fashions for women in all civilized countries are set by Paris; for men, though not so exclusively, by London. One marked feature of the everchanging kaleidoscope of fashion is its tendency to revolve in cycles. Cycles of alternate luxury and simplicity have also distinguished all ages. Fashions change more quickly each decade, a fact due in great measure to increased facilities of communication, while the triumph of democracy is shown by their universal adoption by all classes. Consult: 'Nos Aieules,' translated as 'Ten Centuries of Toilet,' by Mrs. Cashel Hoey (1892). See also *Bibliography* of COSTUME.

Fashoda, fā-shō'dā, Egyptian Sudan town founded in 1867 by the Egyptian government, situated on the Bahr-el-Abiad or White Nile, 400 miles south of Khartum and about 70 miles northeast of the confluence of the Sobat River with the Nile. In July, 1898, it was occupied by a small French force, but some months later it was claimed by the British for Egypt. Ultimately the French force evacuated the town, which was then formally occupied by Sudanese troops.

Fassaite, fas'a-īt, the name applied to a pale green to pistachio or dark green variety of augite, or aluminous pyroxene (q.v.). It occurs in metamorphic, marly limestone in the Fassathal, Tyrol.

Fassett, fas'ĕt, **Cornelia Adèle Strong,** American artist: b. Owasco, N. Y., 9 Nov. 1831; d. Washington, D. C., 4 Jan. 1898. She studied in New York as well as in Paris and Rome, and from 1875 lived in Washington, where she painted portraits of many prominent statesmen. Her most important work is 'The Electoral Commission in Open Session,' including the portraits of some 200 persons.

Fassett, Jacob Sloat, American lawyer and capitalist: b. Elmira, N. Y., 13 Nov. 1853. He was graduated from Rochester University 1875, and was admitted to the bar 1878. He was State senator 1884–90 and was defeated as Republican nominee for governor in the year last named. He is the proprietor of the Elmira *Daily Advertiser,* and controls mining, banking, and other interests in the Western States and in Korea.

Fast and Loose, the name of a cheating game, also called «pricking at the belt,» which appears to have been much practised by English gypsies in the time of Shakespeare, and which is still played at fairs, races, and similar meetings under the name of «prick the garter.» The game consists in trying to pin to a table a belt or similar object so folded as to produce a misleading effect. The original name, in the phrase «to play fast and loose,» has gone into the language to designate the conduct.

Fastenrath, Johannes, yō-hän'-nēs fäs'ten-rät, German poet and story writer: b. Remscheid 3 May 1839. A brief sojourn in Spain (1864) filled him with a permanent enthusiasm for the land and literature which inspired nearly all his life-work. He translated Juan Diana's comedy 'Receipt Against Mothers-in-Law'; and compiled a series of volumes which are less translations than transcriptions in the spirit of the originals — 'A Wreath of Spanish Romances'; 'Hesperian Blooms'; 'The Book of My Spanish Friends'; 'Voices of Christmas.' He has also published several works on the history of Spanish literature; and in Spanish, 'Passion-Books of a German-Spaniard,' a description of the Oberammergau Passion Play; and 'Walhalla and the Glories of Germany.' A volume of war songs dedicated 'To the German Heroes of 1870' is likewise his.

Fasti, fas'tī (Lat. *fasti,* lawful, *fas,* divine law, DIES, days), in ancient Rome, days on which the transaction of business before the prætor was legal, days on which court did not sit being *dies nefasti.* The name thence came to be applied to two sorts of registers or tables: (1) The *fasti sacri* or *fasti kalendares,* containing the calendars of the year. These were at first known only to the *pontifices,* or priests, who announced them to the people, and had thus a source of power and profit. In 304 B.C. Cn. Flavius, who had been secretary to the *Pontifex Maximus* Appius Claudius, Cæcus, exposed them to the people. (2) The *fasti annales* or *historici,* which formed a chronicle of contemporary events, containing the names of the chief magistrates of the year, and a series of the more remarkable events noted in the order of the days of their occurrence.

Fasting, or the practice of self-denial in regard to food and drink has obtained not only in Judaism and Christianity but in the religions of paganism: it is commended to Christians by the example of the prophets of Israel, Moses, Elias, and John the Baptist, and above all by the example and precepts of Christ and his apostles. Under the Mosaic law only one day was appointed to be observed annually by the whole people as a day of fasting — the Day of Atonement; but in addition to that solemn and divinely ordained fast numerous other fasts were enjoined by the Jewish traditional law. In the New Testament no stated days or seasons of fasting are prescribed, nor in the existing records of the Church's history do we find clear proofs of days or seasons of fasting being enjoined on the faithful till the beginning of the 4th century, though the practice of stated fasts was doubtless widely extended at an earlier period. In the strict sense of the word, fasting involves abstinence from all food and drink for a definite period; in the practice of the Church it means abstinence from food on a given day till a certain hour, till noon, or till sunset. The days and seasons of fasting in the Roman Catholic Church are: The 40 days of Lent; the Wednesdays, Fridays and Saturdays of the Ember weeks; the vigils or eves of certain festivals; the Wednesdays and Fridays of Advent. All Fridays throughout the year (except the Friday which happens to be Christmas Day), are «days of abstinence,» that is, days on which the Church forbids the use of flesh-meat. Custom and church legislation have so modified the strict law of fasting, that besides the one meal a «collation,» or light repast, is allowed in the afternoon or evening; and it is permitted to take at the usual hour of breakfast a small quantity of food. The days of fasting prescribed in the Anglican Book of Common Prayer are nearly the same as are observed in the Roman Catholic Church.

Fastnet Lighthouse. See CAPE CLEAR.

Fastolf, fas'tolf, SIR **John,** English soldier: b. Caister, near Yarmouth, about 1378; d. there 5 Nov. 1459. He saw much service in the French wars, and distinguished himself in the battle of Agincourt, the capture of Caen, the siege of Rouen, and other events. He was knighted about 1417, and made governor of the Bastile in 1420. In 1429 he was ordered to bring supplies to the English camp in front of Orleans, then in a state of siege. He went to Paris and obtained the provisions, but when returning was attacked at Rouvray by a French force much stronger than his own. In spite of this disadvantage, however, he succeeded in driving off the attacking party, mainly owing to the skilful manner in which he used barrels of herrings for defensive purposes. The battle is usually known from the last-mentioned circumstance, as the Battle of the Herrings. Some have charged him with cowardly behavior in the subsequent battle at Patay, and it is said that the Duke of Bedford deprived him of the Garter which had been conferred on him in 1426. This charge is, however, probably unfounded. In 1432 he was appointed English ambassador to the Council of Basel, and in 1441 he withdrew from the army. The 'Paston Letters' (q.v.) contain a long account of his later life in Norfolk, and show him to have been keenly bent on amassing a large fortune. He has been regarded as the prototype of Shakespeare's 'Sir John Falstaff.'

Fasts. Among the Jews fasts were numerous; founded on tradition, except that of the day of expiation, which was appointed by Moses. We find, however, fasting mentioned in the Old Testament. Herodotus says that the Egyptians prepared themselves by fasting for the celebration of the great festival of Isis. So in the Thesmophoria at Athens, and in the rites of Ceres at Rome, it was practised. Protestants consider that Christ and his apostles give no precept respecting fasting. It was probably, however, early practised by the Christians as a private act of devotion. The fast days in the Roman Catholic Church are: All the week days of Lent, beginning on Ash Wednesday, the Fridays in Advent, the Ember days, namely, Wednesdays, Fridays, and Saturdays following (1) the first Sunday in Lent; (2) Whitsunday; (3) the 14th of September; (4) the third Sunday of Advent; also the vigils of Pentecost, the Assumption, All Saints, and Christmas. When the vigil falls on Sunday, the fast is kept on the Saturday preceding. The days of abstinence (on which flesh-meat is not allowed) are all Fridays in the year and fast days. Illness, old age, and other causes may entitle a person to a dispensation from these regulations. The Protestant Episcopal Church appoints the following fixed days for fasting and abstinence, between which no difference is made: (1) the 40 days of Lent; (2) the Ember days, at the four seasons; (3) the three Rogation days before Holy Thursday; (4) every Friday except Christmas Day. The Church, however, gives no directions concerning fasting.

Fat-back, a name for the menhaden (q.v.), and for certain mullets, in allusion to the thickness of the dorsal adipose tissue.

Fat-bird, a name among sailors for the guacharo; and among sportsmen in New Jersey for the pectoral sandpiper.

Fata Morgana, fä'tä mor-gä'nä, a remarkable aërial phenomenon observed in the Strait of Messina, and other points in Italy and Sicily, and thus called because supposed to be the work of the fairy Morgana. Objects are reflected sometimes on the surface of the sea, and sometimes on a kind of aërial screen. An object has often two images, of which one is inverted.

Fatalism, the doctrine that all things are ordered for men by the arbitrary decrees of God or the fixed laws of nature. In theology it has given birth to theories of predestination, and in moral science to such systems as those of Spinoza and Hegel, and more recently to the philosophy of Herbert Spencer. It is carried out to its most pitilessly logical extreme among the Mohammedans, where everything that can happen is «kismet,» that is, fated, or decreed by fate. See DETERMINISM; PREDESTINATION; WILL.

Fatality in Color. The color of a soldier's uniform is based upon a principle of fatality. Experience and statistics prove that men are hit in battle according to the color of their dress. Red is the most fatal; the least fatal is Austrian gray. The proportions are: red 12; green 7; brown 6; gray or blue 5.

Fategarh. See FATHIGARH.

Fatehpur. See FATHIPUR.

Fatehpur-Sikri, or **Futtipur-Sikra,** Hindustan, the site of an ancient town in the district of Agra. It was the favorite residence of the Emperor Akbar, who enclosed and fortified it, and the part of the palace containing the apartments of his celebrated prime-minister, Abu-Fazel, is still in good preservation. It is built of dark-red sandstone, in a fine style of Oriental Gothic, adorned with numerous pilasters and rich tracery and carvings, and crowned by two domes. In a tomb of elaborate workmanship, standing in the centre of an arcaded square and approached through a noble gate, several members of the royal family were interred.

Fates, **Μοῖραι,** *Moirai;* Lat. *Parcæ,* in ancient mythology, the inexorable sisters who spin the thread of human life. Homer mentions neither their separate names nor their number. The appellation *Clotho* (the spinner) was probably at first common to them all. As they were three in number, and poetry endeavored to designate them more precisely, *Clotho* became a proper name, as did also *Atropos* and *Lachesis.* Clotho means she who spins (the thread of life); Lachesis, the disposer of lots; Atropos, unalterable fate; so that all three refer to the same subject under different points of view. The first spins the thread, the second determines its length, and the third cuts it. In Homer and Hesiod they appear as goddesses of human fate and individual destiny, both in life and death. Among the lyric poets they seem to have a general power over events, and are always present where anything is to be divided. In the narrowest signification they are the goddesses of death, as of that destiny which closes the scene with all. In this capacity they belong to the infernal world, and are daughters of Erebus and Night. As goddesses of fate they are the servants of Zeus and the offspring of Zeus and Themis. The former genealogy is the more modern. As daughters of Zeus, they have a share in the decisions of fate, and are commissioned by him to execute his commands.

Father, Duties of a. See PARENT.

Father John, or **Father-of-Sickle,** translations of Arabic names for the common or sacred ibis of the Nile region. See IBIS.

Father Prout. See MAHONY, FRANCIS.

Fatherlasher, a small, ugly, cottoid fish, or bull-head (*Cottus bubalis*), from 8 to 10 inches in length. The head is large, and is furnished with several formidable spines. The fish is found on rocky coasts on both shores of the North Atlantic. On the Labrador coast it attains a large size, and is a considerable article of food.

Fathers of the Church, a title bestowed upon certain Church writers who stand preëminent as authorities in the interpretation of Scriptures, the ritual practice of the age they lived in, and the formulation of doctrine as accepted dogma. This authority is weightiest in the Apostolic Fathers (q.v.). Next come the Fathers of the Greek Church, such as Athanasius, Basil the Great, Gregory Nazianzen, and John Chrysostom. Parallel with these are Fathers of the Latin Church, among whom are Jerome, Ambrose, Augustine, and Gregory the Great. While these are the most important of the Fathers, the term is employed with some looseness and often made to include Greek writers like Origen, and Latin writers like Tertullian, whose speculations are sometimes charged with being unorthodox. In modern times, when the study of Christian doctrine has a tendency to become largely historical, the value of the patristic monuments is esteemed more highly than ever before in the progress of European learning.

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Fathigarh, Fategarh, Futtygurh, or **Futtigarh,** British India, a military district of Farnkababad (q.v.), three miles east of the city of that name.

Fathipur, Fatehpur, or **Futtehpur,** British India, capital of the district of the same name, on the highway between Delhi and Calcutta, 70 miles northwest of Allahabad. It contains government buildings and a mosque. Pop. about 22,000.

Fathom. See WEIGHTS AND MEASURES.

Fatigue, a condition of body or of mind brought about by excessive expenditure of energy. Fatigue may occur in any organ of the body as a result of overstimulation; but it is usual to speak of muscular fatigue and nervous fatigue, since the muscle-functions and nerve-functions may be more readily measured; and furthermore, when muscle-tissue and nerve-tissue become tired, this state is associated with certain conscious states that are more or less clearly understood. Fatigue of the sense-organs is included in nerve-fatigue. The sensations, if present, from fatigue, biologically considered, in other organs, such as liver-cells, kidney-cells, etc., are at present little known. The study of protoplasmic fatigue in plants and lower animals promises to open up much heretofore buried knowledge concerning these problems.

Fatigue in muscle results in the main from its excessive use, over and above its capacity to repair by physiological rest. The heart-muscle, while doing an immense amount of work, also does a great amount of resting. Less than one fourth of the time of the heart-cycle is used in contraction. Over three fourths is used in resting. The sense of fatigue is probably a distinct sensation from the organs of muscular sense conveyed to consciousness as a warning to stop excessive muscular activities. The causes leading up to the production of fatigue in muscles are by no means thoroughly understood. The present theory in popular belief teaches that fatigue is due to a form of poisoning of the nerve-end organs in the muscle, the poisonous materials being formed by the metabolism of the muscle — fatigue-stuffs, they have been named by physiologists. If these could be washed out of the muscle the sense of fatigue would go, the muscle-substance itself being apparently unaffected, and conversely, inactive muscles may be made to feel tired if the juices of tired muscles are made to circulate in their blood vessels. What these fatigue-stuffs are is yet undetermined with certainty. They are probably very complex, and probably include substances, like lactic acid and phosphates, that change the chemical reaction of the muscle-plasma, and most likely also a variety of other bodies.

Fatigue in sense-organs, such as taste, smell, touch, etc., may show itself by loss or change of the function. The taste is lost when the stimulation becomes excessive; so with smell and touch; and the same is true for the other sensations. A chemical basis for fatigue in the end-organs is probable, but little is known concerning this. Fatigue in the nerve-cell itself has been widely studied by physiochemical histological methods and certain changes in the nerve-cells seem correlated with fatigue-processes. These involve certain structures in the nucleus and in the stainable constituents (Nissl bodies) of the cells. Fatigue in the reflex arc, as, for instance, in the knee-jerk, is manifested by a steady diminution in the muscular response. Whether the reflexes are purely muscular or neuromuscular phenomena or not, similar changes take place in the end-organs and in the nerve-cells. Mental fatigue is probably closely correlated with the forms of fatigue in other nervous cells of the body. The cells of the brain are probably more complex, both histologically and chemically, than those in other parts of the nervous system, but the changes causing fatigue, and the results in modification of form, are probably of the same kind, if not of the same degree. Tire of the mental functions causes a sympton-complex that is very characteristic. See NEURASTHENIA.

A measure of fatigue-states is possible for most of the simpler muscle and nerve end-organ phenomena, but accurate methods of registering mental fatigue are much needed. School test-methods by which children are made to undergo psychological «stunts» are yielding some very valuable material, although vitiated by much amateurish pedagogical theorizing.

The measuring of the changes in the various reflexes, the nerve-end organs — sensations, perceptions, correlation of ideas, memory-images, etc.— constitutes an important part of a specialist's work in the study not only of normal psychology, but of the abnormal psychology of the insanities. Consult: Schäfer, 'Physiology'; Atwater, 'Digest of Metabolism Experiments'; Ziehen-Sommers, 'Psychophysiologische Methoden'; Verworn, 'General Physiology'; Mann, 'Physiological Histology'; 'American Journal of Psychology'; 'Psychological Review'; 'Educational Review.' See AUTO-INTOXICATION; INSANITY; MUSCLE-EXCITATION; NERVE-CELL; NERVE-FIBRE; NEURASTHENIA; SPECIAL SENSES.

Fatigue of Materials. See STRENGTH OF MATERIALS.

Fatima, fä-tē-mä, (1) The favorite daughter of Mohammed: b. Mecca, Arabia, about 606; d. Medina, Arabia, 632. She had three sons, Al-Hasan, Al-Husein, and Al-Muhsin. From the first two were descended the Saiyides. (2) In 'Aladdin,' the enchantress. (3) In the story of 'Bluebeard' the last wife, and the only one not murdered.

Fatimides, fat'i-mīdz, or **Fatimites,** fat'i-mīts (named from Fatima, the daughter of Mohammed and wife of Ali, from whom the founder of the dynasty described in the definition professed to have sprung), a race of Mohammedan kings, whose founder was Abu Abdallah Husein. Obeid Allah (909–33), subdued northern Africa from the Atlantic coast to Egypt, assumed the title Mahdi («Leader of the Faithful»), established his capital at Mahadi and made himself independent of the Abbassic caliphs. The most important of the dynasty was Al-Mu'izz (955–78), who conquered Sicily and Egypt (972), transferred his court to the latter country, and founded Cairo. Al-Hakim (996–1021) persecuted Jews and Christians, and destroyed the Church of the Resurrection at Jerusalem (1009). His cruelties were a leading cause of the Crusades (q.v.). The dynasty included 14 caliphs, of whom Al-Adhid was the last (1171). Consult: Wüstenfeld, 'Geschichte der Fatimiden-Khalifen' (1881).

Fats. In chemistry, this class of substances was originally understood to include all those compounds of carbon, hydrogen and oxygen which leave a permanent, translucent grease-spot upon paper. In more recent times, however, it has been the custom to include only such bodies of this sort as admit of saponification. Our knowledge of the constitution of the fats is due in large measure to the labors of the French chemist Chevreul, who showed that they are mostly composed of glycerin, in combination with certain organic acids, prominent among which are oleic, stearic and palmitic acids. Fats may be extracted from animal tissues by heat, a temperature of 212° F. being sufficient. From seeds and other vegetable matters in which they occur they are commonly extracted by heating the ground-up tissues, and subjecting them to heavy pressure. As obtained by these methods, the fats often retain fragments of the original tissues in which they occur, as well as certain nitrogenous substances that come away with them. The nitrogenous matter may be removed by shaking the fluid fat (or oil) with sulphuric acid, and the fragments of tissue may be removed by dissolving the fat in ether, carbon disulphid, benzene, or light petroleum, and subsequently filtering the solution and recovering the fat by the evaporation of the solvent. The membranous particles that come away with the animal fats may also be removed by treating the fats with very dilute hydrochloric acid, which dissolves the membranous matter while leaving the fat unaltered.

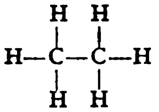
The fats are decomposed when heated to 400° F., by the separation of their glycerin from the fatty acids with which it is combined. They may also be decomposed by saponification, — that is, by boiling them with aqueous solutions of the alkalis,— the decomposition, in this case, being due to the replacement of the combined glycerin by the alkali. The glycerin is thereby set free, and the resulting compounds of the alkali with the organic acids of the fats are known as soaps. (See SOAP.) The rancidity that develops in fats when they are kept for some time is due to the formation or liberation of certain volatile fatty acids, and it may be removed by boiling the fat with water (in which case the objectionable acids are volatilized), or by treating it with an aqueous solution of sodium carbonate (in which case the volatile acids are neutralized by the alkali, with the formation of their unobjectionable sodium salts).

As has been noted above, stearic, oleic and palmitic acids are the commonest of the acids that occur in fats. Their compounds (or «esters») with glycerin are known, respectively, as stearins, oleins, and palmitins, and are markedly similar in their general properties. The nature of these compounds may be sufficiently illustrated by taking stearin as an example. The formula of stearic acid is $H.C_{18}H_{35}O_2$ and that of glycerin is $C_3H_5(OH)_3$. If the two are heated together, they may combine in the following manner: $C_3H_5(OH)_3 + H.C_{18}H_{35}O_2 = C_3H_5(OH)_2.(C_{18}H_{35}O_2) + H_2O$, in which case the compound that is formed is known as «monostearin,» or they may combine in this manner: $C_3H_5(OH)_3 + 2H.C_{18}H_{35}O_2 = C_3H_5(OH).(C_{18}H_{35}O_2)_2 + 2H_2O$, in which case the compound formed is known as «distearin» or, finally, they may combine thus: $C_3H_5(OH)_3 + 3H.C_{18}H_{35}O_2 = C_3H_5.(C_{18}H_{35}O_2)_3 + 3H_2O$, in which case the compound is called «tristearin.» Similar reactions occur with oleic and palmitic acids. The compounds of these three acids that occur most commonly in fats are tristearin, triolein, and tripalmitin.

Fat Tissue, the deposits of fat in various parts of the animal organism. Fat is found in the young of vertebrate mammals from the moment of their birth, and under normal conditions continues to increase till puberty, when a marked diminution takes place. In middle life fat increases, and sometimes is acquired to gross excess. The chief use of fat in a proper quantity, is as a protective shield against atmospheric changes; it serves as a lubricant to several organs, and above all, it stores up the heat energy so essential to animal vitality.

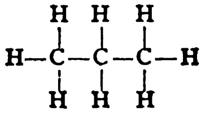
Fatty Acids, monobasic acids formed by the oxidation of the primary alcohols. Such are formic and acetic acids, oleic, stearic and palmitic acids. Thus, when a fat is heated in combination with a stronger base than glycerin, such as potash or soda, the fatty acids leave the glycerin and combine with the metallic base, thus forming soap.

Fatty Compounds, or **Aliphatic Compounds**, in organic chemistry, are those compounds whose molecules do not include a closed chain of carbon atoms. (See AROMATIC COMPOUNDS.) The name «fatty» no longer implies any necessary relation to the fats, but it was originally given to the group because many of its earliest-known representatives occur in the animal or vegetable fats, or are related to them in a simple manner. The name «methane compounds» has also been proposed for the group, but it has not been generally adopted, although it is a particularly happy designation, since all of the compounds of the group are theoretically derivable from methane, CH_4, by addition or substitution. The fatty compounds may be subdivided, in a general way, into those that are «saturated,» and those that are «unsaturated.» Saturated compounds are those in which the atomic linkage is such that no more atoms can be attached to the carbon chain of the molecule, without causing it to split; and unsaturated compounds are those in which this condition is not fulfilled. For example, ethane, C_2H_6, has the structural formula



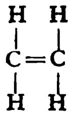
$$\begin{array}{ccccccc} & & H & & H & & \\ & & | & & | & & \\ H & — & C & — & C & — & H \\ & & | & & | & & \\ & & H & & H & & \end{array}$$

and it is therefore a saturated compound, because there is obviously no way to introduce more atoms without separating the carbon atoms, or removing one or more of the hydrogen atoms. If we introduce (say) the group CH_2 («methene»), we must place it between the two carbon atoms, or between a carbon atom and one of the hydrogen atoms now attached to it. In either case the structural formula of the resulting compound (known as «propane,» C_3H_8), is



$$\begin{array}{ccccccccc} & & H & & H & & H & & \\ & & | & & | & & | & & \\ H & — & C & — & C & — & C & — & H \\ & & | & & | & & | & & \\ & & H & & H & & H & & \end{array}$$

so that the new compound is also saturated. Ethylene (q.v.), C_2H_4, is an unsaturated compound, because carbon (according to the present theory) is always a tetravalent element, and a carbon nucleus containing two atoms of carbon is capable of fixing six atoms of hydrogen, as appears in the first of the foregoing structural formulæ. It is, therefore, usual to consider that in this case two valencies in the carbon nucleus satisfy each other, so that the structural formula for ethylene is



$$\begin{matrix} H & & H \\ | & & | \\ C & = & C \\ | & & | \\ H & & H \end{matrix}$$

Here it is obviously possible to introduce two additional monad atoms or radicals, by breaking one of the two valencies uniting the carbon atoms, and attaching one of the monad atoms so introduced to each of the free ends of the valency so broken; the carbon atoms remaining constantly united by *one* of the bonds. If a pair of hydrogen atoms be introduced in this way, ethane is produced, as will be seen by inspecting the structural formula of that substance, given above. In acetylene (q.v.) C_2H_2, three bonds are commonly assumed to unite the two carbon atoms, so that the structural formula of this substance is $H - C \equiv C - H$. Acetylene therefore, is an unsaturated compound. Much attention has been paid to the theory of these double and triple bonds between adjacent carbon atoms, and it has been conclusively established (contrary to what might be naturally assumed) that a double or triple linkage between two carbon atoms constitutes a weaker bond than the single linkage. When, for example, an unsaturated compound is broken up by the action of powerful chemical reagents, it is almost invariably the double (or triple) bond that is ruptured. A quantitative study of the heat-energy liberated when compounds of carbon and hydrogen are burned also shows that the force required to break a double or triple bond is smaller than that required to break a single bond.

Although the fatty and aromatic groups of chemical compounds are differentiated so strongly that it is not easy to convert a representative of either group into a representative of the other one, such a transformation is nevertheless possible. Thus Berthelot showed that when acetylene gas is passed through a red-hot tube it is converted into benzene, naphthalene, and other members of the aromatic group; and an example of the opposite kind of transformation, in which an aromatic compound is converted into a fatty compound, is afforded by the formation of methyl chlorid, CH_3Cl, when hydrochloric acid gas is passed through boiling metaxylene, $C_6H_4(CH_3)_2$. It has been pointed out that there is probably much significance in the fact that the carbohydrates, which are the chief constituents of plants, are fatty compounds containing six (or a multiple of six) atoms of carbon; while the products obtained by the dry distillation of coal (that is, the fossilized remains of such plants), are chiefly aromatic compounds, in which six carbon atoms are united in the form of a «benzene nucleus.» It is likely, in view of this fact, that most of the carbohydrates might be transformed into members of the aromatic group, by the prolonged action of great pressure and moderately high temperature.

Fundamental among the fatty compounds are three series of hydrocarbons, which contain only carbon and oxygen, and are known respectively as the paraffins, the olefines, and the acetylene series. The simplest member of the paraffin series is methane («marsh gas»), CH_4, from from which the higher members are derived by successive additions of the group CH_2, as has already been illustrated in connection with the derivation of propane from ethane. The paraffins are very numerous, and many of the higher members of the series have been but little studied. As will be seen from their mode of derivation from methane, they all come under the general formula C_nH_{2n+2}, where n may have any value from unity up to a limit which probably exists, but is at present unknown. Isomeric forms of the paraffins are possible when n is greater than 3, and the number of such possible isomeric forms increases rapidly with n. Thus in the case of butane, C_4H_{10}, there can be but one isomer, while the compound $C_{13}H_{28}$, known as tridecane, is theoretically capable of existing in no less than 802 distinct forms. See ISOMERISM.

The olefine series of hydrocarbons begins with ethylene («olefiant gas») C_2H_4, from which the higher members may be regarded as derived, just as before, by successive additions of CH_2. The general formula for the olefine series therefore is C_nH_{2n} and many isomers are known here also. The acetylene series, which has not been so thoroughly studied as the paraffins and the olefines, begins with acetylene gas, C_2H_2, and has the general formula C_nH_{2n-2}. See HYDROCARBONS.

Among the derivatives of the fatty hydrocarbons, the fatty alcohols and fatty acids require special mention. Alcohols, as a class, are considered under ALCOHOL. In general, they may be regarded as derived from the hydrocarbons by replacing one or more of the hydrogen atoms by an equal number of molecules of hydroxyl (OH). They are known as «monohydric,» «dihydric,» «trihydric,» etc., according as one, two, three, etc., atoms of hydrogen are replaced in the original hydrocarbon. A vast number of monohydric alcohols are known, but the number of recognized dihydric alcohols (also known as «glycols») is far smaller. Five trihydric fatty alcohols are known, of which glycerin, $C_3H_5(OH)_3$, is the only familiar example; and only one fatty tetrahydric alcohol, erythrite, $C_4H_6(OH)_4$, is known, though a few that are still more highly hydrated have been prepared. The most important series of the monohydric fatty alcohols is that derived from the paraffin series of hydrocarbons, C_nH_{2n+2}, by the substitution of OH for H. The general formula for this series of alcohols therefore is $C_nH_{2n+1}.(OH)$; it includes methyl alcohol, ethyl alcohol, and, in fact, nearly all of the more familiar alcohols. The monohydric alcohols of the olefine series of hydrocarbons have the general formula $C_nH_{2n-1}.(OH)$, but they include only a single familiar example — allyl alcohol, $C_3H_5.OH$. Those of the acetylene series have the general formula $C_nH_{2n-3}.(OH)$, but they do not include any that are of importance save to the theoretical chemist.

The fatty acids are exceedingly numerous, and play a highly important part in the processes of animal and vegetable life. A complete classification of them cannot be here attempted, but three of the known series must be mentioned. The series derived from the paraffins has the general formula $C_nH_{2n}O_2$ and its members may be derived, by oxidation, from the alcohols of the paraffin series that contain the same number of carbon atoms. The best-known examples of this series are as follows:

Formic Acid	CH_2O_2
Acetic Acid	$C_2H_4O_2$
Propionic Acid	$C_3H_6O_2$
Butyric Acid	$C_4H_8O_2$
Capric Acid	$C_{10}H_{20}O_2$
Lauric Acid	$C_{12}H_{24}O_2$
Palmitic Acid	$C_{16}H_{32}O_2$
Stearic Acid	$C_{18}H_{36}O_2$
Melissic Acid	$C_{30}H_{60}O_2$

The alcohols corresponding to these acids have not all been prepared, but many of them have been, and the chemical deportment of the remaining members of the group leaves no doubt of their relation with the normal paraffins from which they are assumed to be derived. All of the foregoing acids are monobasic, containing but one atom of replaceable hydrogen; and these acids, together with the others that belong in the same series, are the ones to which the name "fatty acids" is often applied, by writers on chemistry, to the exclusion of all other organic acids. According to the definition of "fatty compounds" adopted above, however, all organic acids that do not contain closed carbon chains would appear to be logically included under this same title.

Two important series of acids are derived, by oxidation, from dihydric alcohols, or "glycols," of the paraffin series. The general formula for these glycols being $C_nH_{2n}(OH)_2$, the lactic acid series of acids is obtained from them by an oxidation which consists in the replacement of two atoms of hydrogen by one atom of oxygen. The general formula of the lactic acid series therefore is $C_nH_{2n}O_3$. Its most important members are as follows:

Carbonic Acid	CH_2O_3
Glycollic Acid	$C_2H_4O_3$
Lactic Acid	$C_3H_6O_3$
Hydroxybutyric Acid	$C_4H_8O_3$
Hydroxyvaleric Acid	$C_5H_{10}O_3$
Leucic Acid	$C_6H_{12}O_3$

Carbonic acid is included in this list on the hypothesis that it exists in aqueous solutions of the gas in the form $CO_2 + H_2O$. Except for carbonic acid, all the acids of the foregoing list are monobasic. For the reason why carbonic acid is not also monobasic, reference must be made to the more extended treatises on organic chemistry.

The oxalic acid series is derived from the glycol series, given above, by an oxidation which consists in the substitution of two atoms of oxygen for four of hydrogen. The general formula for this series of acids therefore is $C_nH_{2n-2}O_4$. The most important representatives are:

Oxalic Acid	$C_2H_2O_4$
Malonic Acid	$C_3H_4O_4$
Succinic Acid	$C_4H_6O_4$
Pyrotartaric Acid	$C_5H_8O_4$
Adipic Acid	$C_6H_{10}O_4$
Azaleic Acid	$C_9H_{16}O_4$
Sebacic Acid	$C_{10}H_{18}O_4$

The foregoing acids are all dibasic.

The carbohydrates constitute a large and important class of open-chain (or fatty) compounds. They all contain carbon, hydrogen, and oxygen, and are called "carbohydrates" because, like water, they contain precisely twice as many atoms of hydrogen as of oxygen, and can therefore be regarded as consisting merely of water and carbon. O'Sullivan's classification of these substances is given under Carbohydrates; but the carbohydrates are more commonly divided simply into (1) glucoses (or hexoses); (2) saccharoses; and (3) amyloses. The glucoses comprise glucose (or dextrose), fructose (or levulose), galactose, and sorbose (or sorbinose); and they all have the empiric formula $C_6H_{12}O_6$. The saccharoses include cane-sugar, lactose, melezitose and maltose; they all have the empiric formula $C_{12}H_{22}O_{11}$, and are all derived by the union of two molecules of a glucose, with the elimination of one molecule of water. Their general formula may therefore be written $(C_6H_{11}O_5)_2O$, and they may be regarded as related to the glucoses in the same way that ether is related to alcohol. The amyloses include starch, glycogen, dextrin, cellulose, inulin, and the gums. They have the general empiric formula $(C_6H_{10}O_5)_n$, but their structural formulæ are not yet known. Consult: Hjelt, 'Principles of General Organic Chemistry'; Allen, 'Commercial Organic Analysis'; Remsen, 'An Introduction to the Study of the Compounds of Carbon'; Richter, 'Chemistry of the Carbon Compounds'; Perkin and Kipping, 'Organic Chemistry'; Roscoe and Schorlemmer, 'A Treatise on Chemistry'; Meyer, 'Modern Theories of Chemistry'; Cohen, 'The Owens College Course of Practical Organic Chemistry'; Roscoe, 'Lessons in Elementary Chemistry'; and, in fact, any work on organic chemistry. See also, in this encyclopædia, Alcohol; Hydrocarbons; Isomerism; Sugars; and many other titles.

Fatty Degeneration. See Degeneration.

Fatuity, in present usage, synonymous with idiocy (q.v.). Foolishness or weakness of mind.

Fatwa, fut'wā, India, town Patna district, eight miles from Patna, at the junction of the Punpun with the Ganges. Fatwa is a place of great sanctity to Hindus. It is on the East Indian R.R., and has considerable trade. Pop. about 10,900.

Faucigny, fō-sē-nyē, a district of France, department of Haute Savoie; area about 840 square miles. Belongs almost wholly to the basin of the Arve, and not more than one third of its surface is fit for culture. Pop. 102,000.

Faucit, fâ'sit, **Helen** (Lady Martin), English actress: b. London, England, 11 Oct. 1819; d. Wales 31 Oct. 1898. In 1851 she was married to Theodore (now Sir Theodore) Martin (q.v.). She made her professional début as Julia in the 'Hunchback' at Covent Garden in January 1836. She was at once successful, took a leading part in Macready's Shakespearean revivals, in the first representation of Lytton's plays, and in Browning's 'Blot in the Scutcheon' and 'Strafford.' As an interpreter of Shakespeare's heroines, Juliet, Rosalind, Portia, Beatrice, Imogen, Cordelia, and Lady Macbeth, she stood first among the actresses of her time. After her marriage she left the stage, appearing only at rare intervals for public or charitable purposes, as in Beatrice at the opening of the Shakespeare Memorial Theatre at Stratford. In 1885 she published a volume of delightful studies, entitled: 'On Some of Shakespeare's Female Characters' (Ophelia, Portia, Desdemona, Juliet, Imogen, Rosalind, and Beatrice).

Faulkner, fâk'nėr, **Charles James**, American lawyer: b. Berkeley County, Va., 1805; d. 1 Nov. 1884. He was admitted to the bar in 1829, set at various times in both houses of the Virginia legislature and was a member of Congress 1851–60. In the last-named year he was appointed minister to France. Returning to the United States in 1861 he was imprisoned on suspicion of disloyalty, in Fort Warren, Boston, but was exchanged the same year. He was elected to Congress from West Virginia in 1874.

Faulkner's Island, in Long Island Sound, belonging to Connecticut, and about four miles from the mainland. A lighthouse, still in use, was erected here some years ago.

Fault, in geology, any rock-crack or fissure with dislocation of the strata. The rock-movement may accompany the formation of the crack, or may come later, and the total movement may vary from a small fraction of a foot to many thousands of feet. Faults come by the same strains and stresses which make folds, the rocks breaking instead of bending; a brittle stratum may be faulted, while softer strata above or below may be only bent. The dip of a fault is the amount of inclination of the plane of fracture from the horizontal; the hade or slope is the complement of the dip, being the amount of inclination of the plane from the vertical. Thus the hade of a fault with a dip of 60° would be 30°. The rock-strata relatively dropped from the downthrow side; the upthrow side is opposite; the side of the fracture that overlies the other is the hanging wall; the underlying side is the foot-wall. The throw of a fault is the total vertical displacement; the heave is the total horizontal displacement — both measured in the plane of the dip. If a fault dips 45° the heave and throw are equal.

Faults are classified as normal and reversed. In a normal or gravity fault the hanging wall is on the downthrow side. In a reversed or thrust fault the hanging wall is on the upthrow side. Normal faults, as the strata occupy more space than before faulting, were produced by tension. Thrust faults are caused by compression, the beds on one side of the fracture being thrust past those on the other. As a rule thrust faults have lower dips than normal faults. The best examples of great normal faults in the United States are in the Arizona-Colorado plateau. Thrust faults are common in the southern Appalachian Mountains. Generally a fault-fissure is filled with more or less ground-up material from the dislocated strata, and the hanging and foot wall faces are grooved and polished, giving the appearance called slickensided.

It is obvious that faults are essentially surface phenomena; for with increasing depth and increasing pressure from above, rocks bend rather than break, and we can easily imagine a depth at which all rocks, while not truly molten, are plastic. See ESCAPEMENT; GEOLOGY; MOUNTAIN; ORE DEPOSIT.

Faun, fân (Lat. *Faunus*, from *favere*, to be favorable to), in Roman mythology, a Latin rural deity. See FAUNUS.

Faun of Praxiteles, a statue in the Capitoline Museum, Rome, known also as the 'Satyr of the Capitol. It is the best copy extant of an original attributed to the great Greek sculptor and furnished Hawthorne the title for his novel, 'The Marble Faun.' See PRAXITELES.

Fauna, fân'a̤, a term used by zoologists to signify the animals native to a special locality, region, or period of time, as the term "flora" is used by botanists. The term, when prefixed by certain words, is restricted to a more special usage, as "pisci fauna," the fishes of a certain region, etc. Geologists and palæontologists employ the term in a somewhat wider sense, as covering all the animals of a given region, during a geological period — the fossil remains of such animals being found in the successive layers of deposits formed during the entire period in which they lived.

Fauna, in Roman mythology, a Roman goddess, originally called Marica, but after her marriage with Faunus, named Fauna. She is sometimes identified with Cybele.

Faunce, Daniel Worcester, American Baptist clergyman: b. Plymouth, Mass., 3 Jan. 1829. He was graduated from Amherst College in 1850 and was ordained to the Baptist ministry in 1853. He has held various pastorates in New England and elsewhere and has published: 'The Christian in the World'; 'Words and Works of Jesus'; 'Words and Acts of the Apostles'; 'A Young Man's Difficulties with His Bible'; 'The Resurrection in Nature and Revelation'; 'Prayer as a Theory and a Fact'; 'Hours With a Skeptic'; 'Shall We Believe in a Divine Providence?'; etc.

Faunce, John, American naval officer: b. Plymouth, Mass., 25 March 1807; d. Jersey City, N. J., 5 June 1891. He entered the United States marine service as third lieutenant in 1837, and in 1845 was placed in charge of the Long Island and New Jersey life-saving stations. In 1858 he was made commander of the revenue steamer Harriet Lane, which, under his command, accompanied the naval expedition to Paraguay in 1858–9, and which in 1861 was one of the small fleet that was hastened to the relief of Fort Sumter, and was fired on by the Confederates at Charleston. After the War he was detailed to service in the life-saving department, in which capacity he did much toward its thorough organization and perfection.

Faunce, William Herbert Perry, American educator: b. Worcester, Mass., 15 Jan. 1859. He is a son of D. W. Faunce (q.v.). He was graduated at Brown University in 1880, and at the Newton Theological Seminary in 1884; held pastorates in Springfield, Mass., 1884–9, and New York 1889–99; was long a trustee of Brown and Rochester universities; lecturer at the University of Chicago; and preacher at Harvard University. He was made president of Brown University in June 1899.

Faunus, an Italian divinity, probably an ancient Italian king, who instructed his subjects in agriculture and the management of flocks, and was afterward worshipped as the god of fields and of shepherds. The festival of the Faunalia, held on 5 December, referred to the protection he exercised over agriculture and cattle. Fauna was his female complement. He was also worshipped as a prophetic divinity. As deity of the woods and of flocks and herds, he corresponds to the Greek Pan, and hence with his name became associated the attributes of the latter. The idea also arose of a plurality of fauns, like the Greek satyrs, who were represented with short horns, pointed ears, tails, and goats' feet, and to whom all terrifying sounds and appearances were ascribed. Readers of Hawthorne's ‘Marble Faun’ will remember the artistic use there made of the conception.

Fauque de Jonquières, fōk' de zhōn'kē-ãr, Jean Phillipe Ernest, French admiral and mathematician: b. Carpentras, department of Vaucluse, France, 3 July 1820. He entered the navy in 1825 and became an admiral in 1874. He held important commands in Cochin China (1864) and as maritime prefect of Rochefort, and published several valuable mathematical treatises, including ‘Système de courbes et surfaces algébriques d'ordre quelconque (1866).

Fauquier, fâ'kwėr, **Francis,** American colonial governor: b. about 1704; d. 1768. He succeeded Dinwiddie as lieutenant-governor of Virginia in 1758 and retained the office for the remainder of his life. Upon the passing of Patrick Henry's Stamp Act resolutions he dismissed the Virginia house of burgesses, opposed the Stamp Act Congress, and prevented the colony of Virginia from choosing delegates at the invitation of Massachusetts, by refusing to issue writs for summoning the house of burgesses.

Faure, François Félix, frän-swä fā-lēks fōr, French president: b. Paris 30 Jan. 1841; d. there 16 Feb. 1899 He was for a time a tanner in Touraine, but became a wealthy shipowner in Havre, and an authority on all questions concerning shipping, commerce, and the colonies. During the Franco-Prussian war he commanded a body of volunteers and gained the ribbon of the Legion of Honor. He entered the Assembly in 1881, served as colonial and commercial minister in the cabinets of Gambetta, Jules Favre, and Tirard, and as minister of marine in that of Dupuy. A moderate republican, he was elected president of the republic on the resignation of Casimir-Perrier in 1895.

Fauriel, Claude Charles, clōd shärl fō-rē-el, French historian: b. St. Etienne, France, 21 Oct. 1772; d. Paris 15 July 1844. He published: ‘History of Southern Gaul under its German Conquerors’ (1836); ‘The Origin of the Epic of the Middle Ages’ (1833); ‘History of Provençal Poetry’ (1846); and ‘Dante and the Origin of the Italian Language and Literature’ (1854); etc.

Faust, or **Fust, Johann,** yō'hän foust or foost, German goldsmith of the 15th century and one of the persons to whom the invention of printing is generally ascribed. It is, however, doubtful if he did more than advance money to Gutenberg, who had previously made some attempts with movable types at Strasburg. The third person concerned was Schöffer, who married the daughter of Faust, and who is allowed the honor of having invented punches and matrices for casting types, by means of which this grand art was carried to perfection. The first fruits of the new process, that is a work printed with cast letters, appears to have been the ‘Mazarin Bible,’ or ‘Forty-two-line Bible’ (the latter name from the number of lines in a column) completed about 1455. Another early work was ‘Durandi Rationale Divinorum Officiorum,’ published by Faust and Schöffer 1459, followed a year or two after by the ‘Catholicon Johannis Januensis’; after which, in 1462, succeeded the ‘Latin and German Bible,’ so much sought for by those fond of early specimens of typography. There is reason to believe that Faust died of the plague in 1466, as the name of Schöffer alone is found in the books printed after that time at Maintz. Owing, perhaps, to a similarity of name some of the noted deeds of Dr. Faust have been ascribed in popular German legends to the printer.

Faust, foust, or **Faustus,** fâs'tus, **Doctor John,** German magician: b. Knittlingen, Suabia; d. Staufen 1540. The facts of his life have almost entirely disappeared amid the legends and fables in which they have become wrapped up. He appears to have been a charlatan and adventurer who traveled from place to place, putting himself forward as a physician, alchemist, and astrologer, and as a great magician and enchanter. At Würzburg he professed that he could perform all the miracles that Christ performed, and at Wittenberg claimed that the successes of the imperial troops in Italy had been brought about by his magical powers. Among the credulous and ignorant he naturally found many to put faith in his claims and at last his name became associated with a whole series of marvels. The first literary work of which he is the subject was published at Frankfort in 1587, by Johann Spies, and professes to narrate the ‘History of Dr. John Faust, the Far-famed Enchanter, and Professor of the Black Art.’ Enlarged editions soon appeared and the book was translated into English (about 1588), Low German, Flemish, and French. In it we find most of the famous stories associated with Faust's name; how he sold himself to the devil for a period of 24 years; how, by the aid of the fiend Mephistopheles, he and his attendant and pupil, Wagner, were able for this time to enjoy all sorts of sensual delights and to travel about performing the most marvelous exploits, and how at last, when the end of the fatal compact arrived, after a night of dreadful tempest, his body was found almost torn limb from limb, lying on a dunghill at the village of Rimlich, near Wittenberg. It was on the English translation of Spies' book that Marlowe's great tragedy, ‘The Tragical History of Doctor Faustus,’ was based. In 1599 the legendary history of Faust appeared at Hamburg in a new form, as narrated by G. R. Widmann, a zealous Lutheran, always eager to draw a lesson from the events with which he deals. In an altered edition of this by Pfitzer (1674) we first find the germ of Goethe's Margaret, the maiden whose fate is so tragically connected with that of Faust, in the great drama of the German poet. In the second part of his ‘Faust,’ Goethe has attempted a poetical solution of the legend. Through all vicissitudes he leads Faust to a point where at last he experiences the feeling of perfect happiness in devoting his intellectual faculties to the promotion of the welfare of his kind. Then he has attained the end which he has pointed out to Mephistopheles as the object of all his longings, and is removed from this life, not, however, to be lost, but to be saved by love, the «ever-womanly» that «leads us on high.» Goethe's famous poem attempts to show that man's longing after knowledge may lead him into many errors and failings, but cannot destroy his better nature. Goethe's 'Faust' was arranged for the stage by W. G. Wills in 1885. Among the various English translations of Goethe's 'Faust' that by Bayard Taylor is one of the most important. The well-known opera of 'Faust,' by Gounod, was first produced in 1859.

Fausta, Flavia Maximiana, flā'vi-ạ mak″-sim-i-ā'nạ fâs-tạ, Roman empress: d. probably 326 A.D. She was a daughter of the emperor Maximianus Herculius and was married to Constantine the Great 307.

Faustina, Annia, an'i-ạ fâs-tī'nạ (surnamed JUNIOR) Roman empress: d. near Mount Taunis, Asia Minor, 175 A.D. She was a daughter of Annia Galeria Faustina (q.v.) and was married to Marcus Aurelius 145 or 146 A.D. She was noted for her profligacy.

Faustina, Annia Galeria (surnamed SENIOR), Roman empress: b. about 104 A.D.; d. 141. She was the wife of Antoninus Pius, and like her daughter, the wife of Marcus Aurelius, was famed for her licentiousness.

Fava, Onorato, ō-nō-rä'tō fä'vä, Italian author: b. Collobiano, Piedmont, 7 July 1859. He has published: 'Early Follies' (1881); 'Against the Majority' (1888); a novel, 'To the Country of the Stars' (1889); a juvenile, 'Our Life' (1885); 'The Departure of Hannibal' (1891); and various other works, showing as much originality as versatility.

Favara, fä-vä'rä, Sicily, town, four miles southeast of Girgenti. It has mines of sulphur, tourmaline, and alum, and nearby are marble-quarries. Pop. of the commune (1901) 20,400.

Favart, Charles Simon, sharl sē-môṅ fä-vär, French dramatist: b. Paris, France, 13 Nov. 1710; d. there 18 May 1792. His very youthful poem, 'France Freed by the Maid of Orleans,' won the prize of the floral plays; and at 24 he was writing successful comedies. These and his operettas number about 150 (his wife, Marie Justine Benédicte Duronceray, 1727–72, being his constant collaborator), and are for the most part pretty and realistic scenes of love in the country; but some of them are amusing drolleries like the mediæval fabliaux. His most celebrated compositions are: 'Annette and Lubin'; 'The Village Astrologer'; 'Ninette at Court'; 'The Three Sultanas'; 'The Englishman at Bordeaux.' His 'Memoirs and Correspondence' (3 vols. 1808) is of great value for the history of literature.

Favenc, fav'ĕn, **Ernest,** Australian journalist and author: b. London 1846. He was a pioneer in Queensland 1865–79 and since 1888 has been active in journalism. He has published: 'The History of Australian Exploration'; 'Tales of the Austral Tropics'; 'The Secret of the Australian Desert'; 'Marooned in Australia'; 'The Moccasins of Silence'; 'Tales from the Sydney Bulletin.'

Faversham, fav'ėr-shạm, **William,** American actor: b. England 17 Feb. 1868. After serving for a time in the English army in India he went on the stage in 1887 and the next year came to the United States. Since then he has been prominent under Frohman's management in New York.

Faversham (ancient FAVERSFIELD), England, a municipal borough and seaport in the county of Kent, 45 miles east-southeast of London. It contains three suburbs, and has a handsome cruciform church, good schools, a literary institute, and reading-rooms. The chief manufactures are gunpowder, Roman and Portland cement, bricks, and beer; it has large oyster fisheries. It was once the seat of the Saxon kings, and, in 930, Athelstane held here a Witenagemot, or great national council. There are still in existence remains of the abbey built by King Stephen, in 1147, for the Benedictine monks. The tomb of the king, who was buried in the abbey, is now pointed out in the parish church. In 1688 James II., when trying to escape to France, after the landing of William of Orange, was seized at Faversham and sent back to London. Later he succeeded in reaching France. Pop. about 11,290.

Favignana, fä-vēn-yä'nä (ancient ÆGUSA or ÆTHUSA): (1) an island of the Ægades group in the Mediterranean, eight miles from the west coast of Sicily; area, 11 square miles. There is a fine bay on the east on which stand the town and fortress of San Leonardo. San Giacomo, the principal place, is on the north coast. The island has several quarries, and extensive tunny and anchovy fisheries, in the produce of which, and in sheep, goats, and poultry, it has a flourishing export trade. Pop. 5,149. (2) A town of the same name is on the north side of the island.

Favositidæ, fav-ō-sit'i-dē, a palæozoic family of fossil tabulate corals, having the septa and corallites distinct, and little or no true cœnenchyma. The corallites are uniformly prismatic, tall and united by their thick walls, which are perforated by large pores, representing aborted buds. The typical forms (*Favosites*) make large compact masses, taking an important part in the formation of Silurian and Devonian limestones. About 10 genera are indicated by the numerous and widely distributed species.

Favre, Gabriel Claude Jules, gā-brē-el clōd zhül fävr, French politician: b. Lyons 21 March 1809; d. Versailles 20 Jan. 1880. He took an active part in the Revolution of July 1830, studied law, and after distinguishing himself at the Lyons bar came to Paris in 1835, where he became famous as a defender of political prisoners. On the outbreak of the revolution of 1848 Ledru-Rollin made him secretary to the ministry of the interior. He was a leader of the party of opposition to the President Louis Napoleon; and after the *coup d'état* (1851) retired from political life for six years, till in 1858 his defense of Orsini for the attempt on the life of the emperor again brought him forward. From this time he again became an active leader of the Republican opposition to the emperor. On the fall of the empire he became vice-president of the government of national defense and minister of foreign affairs, and as such conducted the negotiations for peace with Prince Bismarck. But though he showed great energy and was very eloquent, his operations both in the matter of the armistice and the peace showed a lack of skill and judgment. He was elected to the French Academy in 1867. He was author of: 'Rome et la République Française' (1871); 'Gouvernement de la Défense Nationale'

(1871–5); 'Conférences et Discours Littéraires' (1873); 'Discours Parlementaires' (1881); 'Mélanges Politiques' (1882).

Favre, Louis, French engineer: b. Chêne-Bourg, near Geneva, 29 Jan. 1826; d. 19 July 1879. In 1872 he gained the contract for constructing the Saint Gothard tunnel within the space of eight years, an engineering feat which he accomplished shortly before his death.

Favus. See RINGWORM.

Fawcett, fâ'set, **Edgar,** American novelist and poet: b. New York 26 May 1847; d. London, England, 1 May, 1904. He was graduated at Columbia College in 1867. His novels are: 'Purple and Fine Linen' (1873); 'A Hopeless Case' (1880); 'A Gentleman of Leisure' (1881); 'An Ambitious Woman' (1883); 'Rutherford' (1884); 'Tinkling Cymbals' (1884); 'The Adventures of a Widow' (1884); 'Social Silhouettes' (1885); 'The Confessions of Claude' (1886); 'The House at High Bridge' (1887); 'Miriam Balestier' (1888); 'A Man's Will' (1888); 'Olivia Delaplaine' (1888); 'A Demoralizing Marriage' (1889); 'Fabian Dimitry' (1890); 'A New York Family' (1891); 'An Heir to Millions' (1892); 'Women Must Weep' (1892); 'A Mild Barbarian' (1894); 'Outrageous Fortune' (1894); etc. His poetical works include: 'Short Poems for Short People' (1872); 'Fantasy and Passion' (1877); 'Song and Story' (1884); 'Romance and Revery' (1886); 'The New King Arthur'; 'Songs of Doubt and Dream' (1889).

Fawcett, Henry, English political economist: b. Salisbury, England, 26 Aug. 1833; d. Cambridge 6 Nov. 1884. An accident which deprived him of sight early in life did not prevent his attainment of distinction as postmaster-general in 1880. He was the author of 'Manual of Political Economy' (1863); 'The Economic Position of the British Laborer' (1865); 'Pauperism: Its Causes and Remedies' (1871); and 'Protection and Reciprocity' (6th ed. 1885), in which the liberal theory of the younger Mill is carried to its logical extreme; 'Labor and Wages' (1884). See Stephen, 'Life of Henry Fawcett' (1885).

Fawcett, Millicent Garrett, English political economist: b. Aldeburgh, Suffolk, 11 June 1847. She was married to Henry Fawcett (q.v.) 1867. She has taken a very prominent part in many movements relating to women, more particularly in that for obtaining the parliamentary franchise for them. In 1889 she was elected president of the Women's Unionist Association. Her published works include: 'Political Economy for Beginners' (1870); 'Tales in Political Economy' (1875); 'Janet Doncaster,' a novel (1875); 'Some Eminent Women of Our Time' (1889); and 'Life of Queen Victoria' (1895); 'Life of Sir William Molesworth' (1901). With her husband she published in 1872 a volume of 'Essays and Lectures.'

Fawkes, fâks, **Guy,** English conspirator: b. York, England, 1570; d. Westminster 31 Jan. 1606. He enlisted in the Spanish army in the Netherlands, where he was found by Winter, one of the Roman Catholic conspirators, and with him returned to England in 1604, after agreeing to assist in the Gunpowder Plot (q.v.). He passed under the name of Johnson, as servant to Thomas Percy, another conspirator, and was placed to lodge in the house next to the Parliament House. After collecting the necessary combustibles, Fawkes worked his way into the coal cellar under the House of Lords, and after storing it with gunpowder, etc., was appointed to the dangerous duty of firing the mine. The government having had timely information of the detestable plot, the House of Lords and its cellar were searched, and Fawkes found secreted amid some casks of gunpowder, 5 Nov. 1605. He was at once arrested, and suffered death at Westminster with several of the other conspirators.

Fay, Amy, American lecturer on music: b. Bayou Goula, La., 21 May 1844. She has published 'Music Study in Germany.'

Fáy, fī or fāy, **Andreas,** Hungarian author: b. Kohány, Zemplin, Hungary, 30 May 1786; d. Pest 26 July 1864. Till the appearance of Kossuth on the scene (1840) he was the foremost leader at Pest of the Opposition party; thereafter he took no considerable part in politics, but promoted many important national enterprises. His volume of poems, 'New Garland' (1818) established his fame as a poet, but his admirable prose 'Fables' (1820) attained a far wider popularity. Among his dramatic works are the tragedy, 'The Two Báthorys' (1827); and several comedies, the most notable being 'The Old Coins; or the Transylvanians in Hungary' (1824), and 'The Hunt in the Matra' (1860). His social novel, 'The House of the Béltekys' (1832), and a number of short stories, entitle him to a place among the great masters of Hungarian prose.

Fay, Charles Ernest, American educator and mountain climber: b. Roxbury, Mass., 10 March 1846. He was graduated from Tufts College in 1868 and has been professor of modern languages there from 1871. He has been several times president of the Appalachian Mountain Club and has been very prominent in the development of mountaineering in the Canadian Rocky and Selkirk mountains. He has lectured publicly on literary and geographical themes, and has edited 'Appalachia' from 1879.

Fay, fī, **Joseph,** German painter: b. Cologne 10 Aug. 1813; d. Düsseldorf 27 July 1875. His art education began in the Düsseldorf Academy and was continued in Paris where he turned his attention to historical painting. His first picture, 'Samson and Delilah,' was exhibited in his 27th year. He painted a series of frescoes in the Council Chamber at Elberfeld, in which was portrayed the history of Germany from the destruction of the Varian legions. The work is creditable. His fertile pencil produced among other pictures, 'Thisbe'; 'Romeo and Juliet'; 'Gretchen.' He later on paid some attention to genre, depicting scenes in Italian life, reminiscences of travel in the peninsula. Felicitous conception, brilliant coloring and dextrous brush work are conspicuous in his productions.

Fay, Theodore Sedgwick, American writer: b. New York 10 Feb. 1807; d. Berlin, Germany, 17 Nov. 1898. He was eminent in periodical journalism for years. To this period belongs his book, 'Dreams and Reveries of a Quiet Man' (1832). He served with ability in the United States diplomatic service, and wrote: ‘Norman Leslie’ (1835); and ‘The Countess Ida’ (1841), tales; ‘Ulric’ (1851), a poem; ‘The Three Germanys’ (1889); ‘Great Outlines of Geography’; ‘History of Switzerland,’ etc. After 1861 he lived in Berlin.

Fayal, fī-âl'; Port. fī-äl, one of the Azores group, in lon. 28° 41' W.; lat. 38° 31' N. It is circular in form, about 10 miles in diameter; area 69 square miles. It rises abruptly from the sea, and the centre is about 3,000 feet in height. The climate is temperate all the year. Volcanic eruptions have taken place, but not in recent years. The soil is fertile, and the principal productions are wheat, maize, flax, fruits. Hunting small game, fishing, raising cattle, and agriculture are the leading occupations. Horta or Orto is chief port. Pop., estimated, 40,000.

Faye, Hervé Auguste Etienne Albans, ār-vā ō-güst ā-tē-en äl-bäṅ fā, French astronomer: b. St. Benoit du Sault, France, 5 Oct. 1814; d. Passy, near Paris, 4 July 1902. He studied at the École Polytechnique, where he was professor of geodesy in 1848–54, and later of astronomy, and at the Paris Observatory. He discovered the comet which bears his name in 1843; became rector of the university academy of Nancy in 1855; inspector-general of higher education in 1877; and was made chevalier of the Legion of Honor in 1843, and promoted to grand officer of the Legion in 1889. He wrote several books on astronomical subjects, among which are: ‘Sur l'Origine du Monde’; ‘Cours d'Astronomie Nautique.’

Fayence. See Faïence.

Faye's Comet, discovered by the astronomer Faye 22 Nov. 1843. It has returned in the years 1851, 1858, 1865, 1873, 1880, 1888, and 1895. See Comets.

Fayerweather, fãr'-wet'h ėr, **Daniel B.,** American merchant and philanthropist: b. Stepney, Conn., 1821; d. 1890. He was long prominent in the leather business in New York and bequeathed some $5,000,000 to educational and charitable institutions, which is now (1904) being contested and the case is pending in the United States Supreme Court.

Fayette, fā-et', Iowa, town in Fayette County; on the Chicago, M. & St. P. R.R.; 65 miles northwest of Dubuque. It is the seat of Upper Iowa University, a Methodist Episcopal institution founded in 1857, one year after the settlement of the town. It is located in an excellent agricultural section. Pop. (1910) 1,112.

Fayette, Mo., city, county-seat of Howard County; 105 miles east by south of Kansas City; on the Missouri, K. & T. R.R. It is the seat of the Howard Payne College for women, founded in 1844, and the Central College, coeducational, founded in 1857, both under the auspices of the Methodist Episcopal, South, Church. It is in an agricultural section and the trade and industries are connected with agricultural products. Pop. (1910) 2,586.

Fayetteville, fā-et'vil, Ark., city, county-seat of Washington County; on the St. Louis & S. F. R.R.; in the Ozark Mountains. It is a well-known summer resort and is called the «Athens of Arkansas.» Fayetteville is a fruit centre for northwestern Arkansas. It is the seat of the Arkansas Industrial University. Its chief manufactories are a foundry, flour-mills, large wagon factory, and fruit evaporating establishment. Pop. (1910) 4,471.

Fayetteville, N. C., city, county-seat of Cumberland County; on Cape Fear River, and on the Central Coast Line, and the Cape Fear and Y. V. R.R.'s, 120 miles south of Wilmington. It contains a high school, military academy, a State colored normal school, a bank, and several newspapers. It has manufactories of edge tools, carriages, wooden-ware, flour, turpentine, cotton, etc. On 22 April 1861, the Confederates seized the United States arsenal at this point. Gen. Sherman occupied the town 11-14 March 1865, and destroyed the arsenal. Pop. (1910) 7,045.

Fayetteville, Tenn., town, county-seat of Lincoln County; on the Elk River, the Nashville, C. & S. L. R.R.; 180 miles east of Memphis. The Fayetteville Collegiate Institute and Dick White College are located here. The manufactures are flour, lumber, wagons, and dairy products. Pop. (1910) 3,439.

Fayum, or **Fayoum,** fī-oom', **The** (Egypt. *Phiom,* «marsh-land»), a province of Egypt, consisting of a nearly circular basin or oasis, about 30 miles in diameter, or 840 square miles in area, sunk beneath the level of the Libyan desert, about half a degree south of Cairo, and connected with the Nile valley by a narrow pass, through which an ancient canal flows. This canal is the Bahr-Yûsuf, or «Joseph's stream,» so named after Saladin, who restored an original construction of the Theban Pharaohs, which pours the fertilizing water which renders the Fayyûm one of the most productive parts of Egypt. The irrigation was anciently regulated by a large reservoir, called Lake Mœris (q.v.), described by the Greeks as a work of extraordinary hydraulic ingenuity, and the overflow now forms the large sheet of brackish water, 35 miles long, known as the Birket-el-Karn, which marks the eastern boundary of the oasis. The site was identified by Linant near the modern capital Medinet-el-Fayyûm, though other sites have been proposed by Cope, Whitehouse, and others. On the banks of Lake Mœris was the famous Labyrinth, probably built by Amenhemhat III., and reckoned one of the wonders of the world. The remains of this vast palace are seen in the ruins of numerous chambers near the brick pyramid of Hawâra. The capital of the Fayyûm was Crocodilopolis, afterward named Arsinoë, after the queen of Ptolemy Philadelphus, near the site of which is the modern chief town (pop. 31,262). Fidimin is a picturesque village in the Fayyûm. Recent explorations by Petrie and others have revealed more interesting remains of antiquity in the province than had formerly been suspected. The Fayyûm abounds in fruit, oranges, peaches, pomegranates, olives, figs, grapes, etc., and is famous for roses and other flowers. The inhabitants are chiefly agriculturists and fishermen. The fields yield splendid crops of cereals, besides rice, cotton, sugar, flax, and hemp. Pop. 160,000. Consult, for an account of excavations in the Labyrinth, the ruins at Hawâra, etc., Flinders Petrie, ‘Hawâra and Arsinoë’; Brown, ‘The Fayyûm and Lake Mœris’ (1893).

Fea, fē, **Allan,** English antiquarian: b. 25 May 1860. He was employed in the Bank of

England 1880-90, and is the author of: 'The Flight of the King'; 'Secret Chambers and Hiding Places'; 'King Monmouth.'

Fealty, loyalty; faithful adherence; true service or duty to a superior lord, the obligation which bound the tenant, especially in feudal times. Fealty, suit of court, and rent, were conditions upon which the ancient lords granted their lands to feudatories; it being stipulated that they and their heirs should take the oath of fealty or fidelity to their lord, which was the feudal bond (*commune vinculum*) between lord and tenant; that they should do suit, or duly attend and follow the lord's courts, and there from time to time give their assistance, by serving on juries either to decide the property of their neighbors in the court baron, or correct their misdemeanors in the court leet; and lastly, that they should yield to the lord certain annual stated returns, in military attendance, in provisions, in arms, in matters of ornament or pleasure, in rustic employments (prædial labors), or (which is *instar omnium*), in money, which provided all the rest; all of these services being comprised under the one general name of redditus, return, or rent. The right of fealty still exists in England, but is exacted only from copyholders. It lasted in the United States for a short time after the Revolution, but soon became obsolete.

Fear, apprehension of approaching evil, danger or harm; solicitude, dread, terror. The term fear is also used in the sense of respect for and obedience to authority, especially as these take the form of awe and reverence toward the Supreme Being, with due regard to his law and word. The operation of fear on the mind is often, if uncorrected, attended with the most serious consequences, especially where sickness is present or disease threatened. On many persons the influence of fear is far more serious in its effect than the worst form of any dreaded malady. In epidemic diseases the terror they inspire is often as fatal as the infection — paralyzing the system, and robbing the body of the natural elasticity of its nervous stamina, and the mind of the buoyancy of hope, making victims of those who, from age and strength, had the best probability of escaping. Fear is a mental poison, and the most potent of all antagonists to health and medicine; it is often fatally active in the morbid developments which result in various forms of insanity; and as faith has cured more diseases than physicians ever prescribed for, so fear is more destructive than the worst physical malady. In the conflicts of the modern business world, especially in monetary centres, its contagion now and then breaks out in fright which imperils the fortunes of individuals, or a people's financial stability, as a country's cause is sometimes lost through panic striking its armies in battle. Recent psychology finds in fear one of its most important subjects for analysis and definition; and the physician, the teacher, the moralist, and the sociologist all deal with it as an element calling for special study and control in the development of the individual and of society at large. See EMOTION.

Fearnley, fĕrn'lĭ, **Carl Frederik,** Norwegian astronomer: b. Frederikshald 19 Dec. 1818; d. Christiania 22 Aug. 1890. He studied at Bonn and Königsberg, returning to Christiania and becoming professor of astronomy at the university 1857, and director of the observatory 1861. He was appointed head of the geodetic survey of Norway 1876. He published: 'Zur Theorie der terrestrischen Refraction' (1884); 'Zonenbeobachtungen der Sterne zwischen 64° 50′ und 70° 10′ nördlicher Deklination' (1888).

Fearnley, Thomas, Norwegian landscape painter: b. Frederikshald 27 Dec. 1802; d. Munich 16 Jan. 1842. He studied at Copenhagen, and subsequently traveled much, painting excellent landscapes, most of which are in England. Among his works are: 'Copenhagen' (1823); 'View of the Marumelf'; 'Justeldas Glacier'; 'Duck Shooting'; 'Romsdalhorn'; 'Grindelwald Glacier'; 'Waterfall and Sawmill'; 'Sorrento'; 'Madumsfall'; 'Castelmare'; 'Moonlight'; 'Gravius Fjord'; 'View in Norway'; 'Labrofos Waterfall.'

Feast, a festival, banquet, solemnity, holiday, etc. Almost every religion has had its solemn feast-days. The ancient Greeks and Romans had them, as well as the Jews and modern Christians. According to the Old Testament, several festivals among the ancient Jews were divinely appointed, the first and most ancient of which was the Sabbath, or seventh day of the week, commemorative of the creation. The Passover was instituted in memory of their deliverance out of Egypt, and of the favor of God in sparing their first-born when those of the Egyptians were slain. The feast of Pentecost was celebrated on the 50th day after the Passover, in memory of the law being given to Moses on Mount Sinai. The feast of Tents or Tabernacles was instituted in memory of their fathers who dwelt in tents for 40 years in the wilderness; and all Israel was obliged to attend the temple and dwell eight days under tents. These were their principal feasts, but they had numerous others — the feast of Trumpets, the feast of Expiation or Atonement, the feast of the Dedication of the Temple, etc.

In the Christian Church no festival appears clearly to have been instituted by Jesus or his apostles, yet Christians have always celebrated the memory of his resurrection, and numerous other feasts were introduced at an early period. At first they were only appointed to commemorate the more prominent events in the life and death of Christ, and the labors and virtues of the apostles and evengelists; but martyrs were soon introduced, and by the 4th century the number of feasts had very greatly increased. Many of the festivals were instituted on pagan models, and were characterized by rites similar to those which the pagans observed.

Feasts are either movable or immovable. Immovable feasts are such as are celebrated constantly on the same day of the year, among them being Christmas Day, Circumcision, Epiphany, Candlemas or Purification, Lady-day or the Annunciation, All-Saints', All-Souls', and the days of the several apostles, as St. Thomas, St. Paul. Movable feasts are those which are not confined to the same day of the year. Of these the principal is Easter, which gives law to all the rest, all of them following and keeping their proper distances from it; as Palm Sunday, Good Friday, Ash Wednesday, Sexagesima, Ascension Day, Pentecost, and Trinity Sunday. Besides these, which are general, there are others which are local or occasional, enjoined by the magistrate, or voluntarily set on foot by the people, such as, in this country, Independence Day, celebrated annually on the 4th of July, and Thanksgiving Day, also held every year on a day set apart by the President for the occasion. See FOOLS, FEAST OF.

Feather, one of the elastic horny dermal outgrowths of the skin, forming plumage, the characteristic covering of birds. See PLUMAGE.

Feather Bunch-grass (*Stipa viridula*), a rather slender grass, one to three feet high, growing in the Rocky Mountain region and on the foot-hills and mesas, from British Columbia southward to Mexico and westward to the coast. On good land, under irrigation, this grass attains the height of three feet or more, and is by far the most valuable of the *Stipas* for hay. The leafy culms are terminated by a narrow, many-flowered panicle of comparatively small and rather short-awned spikelets. The seed may be easily gathered. The callus at the base of the fruiting glume is short and barely pointed and not produced into a long, very sharp, spur-like extension, as in porcupine-grass.

Feather-star, a crinoid of the existing family *Comatulidæ*, which is composed of several genera of highly developed crinoids which differ from the «stone-lilies» and other existing forms in swimming freely as adults instead of being rooted by a stalk. The headquarters of the family is in the Malayan seas, but several species occur on the American and British coasts, and one of the latter, the rosy feather-star (*Antedon rosaceus*), has been exhaustively studied, contributing greatly to our knowledge of the whole group. It has the general characteristics of a crinoid (q.v.), and when young is attached to a long stalk, but when full grown drops off and thereafter creeps and swims about, back downward, by means of five pairs of radiating arms which are so fringed and flexible that they look like feathers. These arms expand about three inches.

Feather-tracts, one of those regulated spaces where feathers grow on the body of a bird, the arrangement of which is various and characteristic of groups. This regular distribution of feather-growths is known as «pterylosis,» and the study of it as «pterylography.» Pterylosis is further treated under PLUMAGE.

Feather-wings, a plume-moth (q.v.).

Feathering Float, the paddle or float-board of a paddle-wheel, so arranged as to turn on an axis to present its broad side to the water at its lowest submergence, but to turn its edge to the water in entering and emerging.

Feathering Paddle-wheel, a wheel whose floats have a motion on an axis, so as to descend nearly vertically into the water and ascend the same way, avoiding beating on the water in the descent and lifting water in the ascent.

Feathering Propeller, an invention of an Englishman, Maudslay, in which the vanes of the propeller screw are adjustable, so as even to be turned into the plane of the propeller-shaft and offer no resistance when the vessel is under sail and the propeller not used.

Feathers, Artificial. Artificial feathers and flowers have long been made in the United States. It is probable that the industry was brought here by French immigrants, who had fled from their own country. The number of French people here was soon increased by those who had come hither from the island of Haiti. It was necessary that these strangers should live, and one of the first industries they took up was artificial flower and feather making. Artificial feathers serve as cheap decorations for ladies' hats and bonnets. As long ago as 1840 there were 10 manufacturers in this line in New York. No separate enumeration of these products appears in the early census returns, but the quantity demanded increased greatly. Within the past few years a great change has taken place; feathers now being used as trimming on ladies' dresses, and as boas and collars. New York is the principal seat of the industry.

Featherstonhaugh, feth'ėr stŭn hâ, **George William**, English traveler in America: b. 1780; d. Havre, France, 28 Sept. 1866. He made geological surveys in the West for the United States War Department 1834–5, and was appointed by Great Britain a commissioner to determine the northwestern boundary between Canada and the United States, under the Ashburton-Webster treaty. He was the author of numerous technical reports and papers, including the 'Geological Report of the Elevated Country Between the Missouri and Red Rivers' (1834); 'Excursion Through the Slave States' (1844); 'Canoe Voyage to the Minnesota' (1847), etc.

Feb'iger, John Carson, American naval officer: b. Pittsburg, Pa., 14 Feb. 1821; d. Londonderry, Pa., 9 Oct. 1898. He was appointed a midshipman in the navy in 1838; became commander 16 July 1862, and was assigned to the steamer Kanawha of the Western Gulf blockading fleet. On 5 May 1864, while in command of the Mattabeset, of the North Atlantic fleet, he participated with the little squadron under Capt. Melanchthon Smith in defeating the Confederate ram Albemarle, in Albemarle Sound, N. C., and was commended for his bravery and skill in that engagement. He was promoted rear-admiral 4 Feb. 1882.

Febrifuge, feb'rĭ-fūj, a remedy used to destroy or mitigate fever. When rise in temperature was considered the important feature of a disease and this single symptom was considered apart from the rest of the life history of a disease process, febrifuges were much in use, but at the present time, when a disease is considered in its entirety rather than from its purely symptomatic manifestations, this class of remedies has fallen into a position of less prominence. High temperatures are now looked upon as evidences of a reaction in the body in its struggle with disease and, unless excessive and prolonged, should not necessarily be interfered with. A temperature of 103° to 104° F. is rarely harmful, but when the thermometer registers above 104° F. it is advisable to reduce it, for which purpose cold packs and cold sponging are among the best means. Such drugs as the newer synthetics, acetanilid, antipyrine, phenacetine, salol, and other like derivatives, and aconite, diaphoretics, etc., are still much in use; but only within restricted limits may they be said to be curative. In malaria, the high temperature being due to the development of large numbers of parasites in the blood, quinine, by killing the parasites, destroys the fever. See Animal Heat; Antipyretics; Fever.

Febrile. See Fever.

Febro'nianism (from Justinus Febronius, a pseudonym assumed by John Nicolaus von Hontheim, archbishop of Trèves), a system of doctrines antagonistic to the admitted claims of the Pope, and asserting the independence of national Churches, and the rights of bishops to unrestricted action in matters of discipline and church government within their own dioceses. Febronianism is opposed to Ultramontanism (q.v.), and developed into the Old Catholic Movement.

February. See Calendar.

February Revolution, The, in French history, the revolution of 1848, which brought about the fall of the July monarchy. See France.

Febvre, Alexandre Frédéric, äl-ek-sŏṅ-dr frā-dā-rik fevr, French actor: b. Paris 1835. He made his début at Havre, subsequently appearing in Paris at the Beaumarchais, the Porte St. Martin, the Gâité, the Odéon and the Ambigu theatres. He is very successful in comedy, among his principal creations being Clarkson in ‘L'Etranger’; Kobus in ‘L'Ami Fritz,’ and Bourdon in ‘Les Corbeaux.’ He went to London with a company in 1877, making his farewell appearance at the Théâtre Français in 1893, «touring» the principal cities of Europe in 1894, and was sent to the United States to study the drama here in 1895. He is the author of ‘Album de la Comédie Française’ (1880); ‘Au bord de la Scène’ (1889); ‘L'Heritage de Mme. Naudin’ (1893); ‘Le Journal d'un Comédien’ (1896); ‘La Clef des Champs’ (1899).

Fécamp, fā kän, France, town in the department of Seine-Inférieure, at the mouth of a stream of the same name, 23 miles northeast of Havre. It stretches along a narrow valley enclosed by two parallel ranges of hills, and has a parish church, which originally belonged to the famous abbey of Fécamp, a school of hydrography, manufactures of cotton, linen, and woolen goods, sugar works, tanneries, building yards, several mills, a valuable fishery, and a spacious harbor with deep water and good anchorage. The town was celebrated for its herring fishery as early as the 13th century. Pop. about 16,000.

Fechner, Gustav Theodor, goos täf' tā'ō dōr fĕн'nĕr, German philosopher: b. Gross Särchen, Prussia, 19 April 1801; d. Leipsic 18 Nov. 1887. His works on purely scientific topics, ‘Elements of Psychophysics’ (1860), and ‘Text Book of Experimental Physics’ (1828) among them, and his ‘Three Motives and Grounds of Faith’ (1863), are well known, while under the name of «Doctor Mises» he wrote various popular humorous and satirical works, notably, ‘A Proof that the Moon is Made of Iodine’ (1821); ‘Comparative Anatomy of the Angels’ (1825); and ‘The Little Book of Life After Death’ (1836). See Kuntze, ‘Gustav Theodor Fechner, ein deutsches Gelehrtenleben’ (1892); Lasowitz, ‘Gustav Theodor Fechner’ (1896).

Fechter, Charles Albert, sharlz äl-bār fĕн-tĕr, French actor: b. Belleville, near Paris, 23 Oct. 1824; d. Quakertown, Pa., 4 Aug. 1879. He made his first public appearance in 1840 at the Salle Molière, in Paris, after which he went to Florence with a dramatic company as leading juvenile. Subsequently he apeared as Seide in Voltaire's ‘Mahomet,’ in 1844; as Valère in Molière's great comedy; and as Armand Duval in ‘La Dame aux Camelias.’ In 1860 he went to London, where he presented ‘The Corsican Brothers,’ ‘Don César de Bazan,’ and ‘Hamlet.’ In 1870 he came to the United States and played to crowded houses, being especially popular in ‘The Count of Monte Cristo.’

Fecial. See Fetial.

Feckenham, fek'ĕn-ạm, or **Fecknam,** fek'nạm, **John de,** English Roman Catholic prelate: b. Feckenham Forest, Worcestershire, about 1516; d. Wisbech, Cambridgeshire, 1518. He served as chaplain to Bell, the bishop of Worcester Bell, and to Bonner, the bishop of London, going as a prisoner to the Tower upon Bell's fall 1549. Upon Queen Mary's accession to the throne he was made chaplain 1553, later becoming dean of St. Paul's. He held a conference with Lady Jane Grey shortly before her execution. He became abbot of Westminster 1556, and was a member of Queen Elizabeth's first parliament, the last mitred abbot to appear in that legislative body. Being active against the Reformation he was again sent to the Tower 1560, was released 1574, but kept under surveillance as long as he lived.

Fecundation. See Pregnancy.

Federal Courts. See Court.

Federal Government. Federal is derived from the Latin *fœdus,* a league, treaty, covenant, and applied to the governments of confederations, which consist of several united sovereign states, as, for instance, the United States, Switzerland, Mexico, etc. The degree to which such states give up their individual rights as sovereign bodies may be very different. Thus, the old German empire was a confederation under a head, and yet one member of it might wage war with another; while the different members of the United States have given up, among other things, all political power in so far as it relates to foreign affairs. In the Swiss Confederation the different members are allowed to conclude treaties with foreign powers, if they are not expressly prohibited by the constitution. It must be observed that every confederation has not a federal government, because sometimes a confederation consists merely of a union between a number of states, not stricter than a treaty, defensive and offensive, between two states, as, for instance, the former Germanic Confederation. See Government.

Federal Hall, New York city, originally the City Hall, built 1699 in Nassau Street, to replace the old Dutch «stadt-huys.» It had a cage in front for criminals, a whipping-post, and stocks. On the assumption of independence it was made the State capitol; the Declaration was read in front of it, and Washington was inaugurated on its steps 4 March 1789. In 1836 it was torn down, and the sub-treasury building erected on its site.

Federal States, states united by a federation or treaty which, binding them sufficiently for mutual defense and the settlement of questions bearing on the welfare of the whole, yet leaves each state free within certain limits to govern itself. Switzerland and the United States are examples of this political constitution. Such a union or confederation is sometimes known as a federacy. The term federation indicates centralization in government, while confederation is used where state sovereignty is stronger.

Federalist, The (1787-8). When the text of the Constitution was published in New York 27 Sept. 1787, the opposition was at first overwhelming; the State held too advantageous a position, as general gatekeeper of the commerce of her neighbors and able to support herself by levying customs duties on them, to surrender it. Unless New York ratified the Constitution, there could be no Union; and New York certainly would not ratify it as things stood. Alexander Hamilton, therefore, induced James Madison and John Jay to unite with him in publishing a series of anonymous essays to defend the new instrument and urge its absolute necessity; Gouverneur Morris was asked to join, but declined. From 27 Oct. 1787 to 2 April 1788, 77 essays were published in the semi-weekly 'Independent Journal' of New York, entitled, 'The Federalist,' and signed first «A Citizen of New York,» then «Publius.» Eight more were added when they were collected in book form. Their influence was enormous not only in New York, where they greatly aided the final ratification by two votes, but elsewhere the essays circulated extensively in pamphlet form; they were so acute and massively learned in their exposition of the true intent of the Constitution, that even the courts have accepted them as authoritative comments in doubtful cases; and they are held by all the civilized world as among the noblest storehouses of political philosophy in existence, a classic text-book of political science. The exact authorship is matter of debate. Jay certainly wrote 5; Hamilton's son claimed 63 for his father and 3 for him and Madison jointly, leaving the latter 14, but Madison in 1819 claimed 29 for himself alone, leaving Hamilton 51. John Fiske thinks Madison's 29 much the most valuable for constitutional exposition; the Hamiltonians can claim half of them. There are many editions; the best is Paul Leicester Ford's indexed edition of 1898. In John C. Hamilton's of 1875 he has a long essay on the authorship.

Federalists, or Federal Party, in the United States; in power 1789-1801; died nationally about 1817, locally about 1823; the lineal ancestor in succession of the National Republican, Whig, and present Republican parties. Its origin (see Anti-Federalists) was on the question of adopting the Constitution; but it represented two unrelated elements. The commercial interests wished protection at once from foreign aggression, and from barriers set up by independent selfish State legislatures; the patriots pure and simple wished a strong and energetic nation, able to command respect and secure fair treatment. The union of these, their reinforcement for the time by the more statesmanlike even of the Anti-Federalists and Washington's influence, gave them complete control of the new government. They organized the executive departments (see Executive) anew, and created the federal judiciary and the Territorial system. The Hamilton, the greatest man of the party and its natural leader, pushed through his schemes for paying the foreign and funding the domestic debt in full, restoring national credit and for assuming the State debts, binding the States to support the new government (see District of Columbia for the «log-roll» which carried it); excise laws, a United States bank, a protective tariff and bounty system to develop manufactures and agriculture, and a postal system, followed rapidly; and in 1794 the crushing of the Whiskey Insurrection (q.v.) showed the new national strength. Meantime the refusal to be dragged into an alliance with revolutionary France had fused the Democrats with the Republicans, the successors of the Anti-Federalists; and Jefferson had organized and Madison joined the new Democratic-Republican party. The most influential Federalist leaders besides Hamilton were Adams and Jay, among others were the «Essex Junto» (q.v.), Fisher Ames, Roger Sherman, Jonathan Trumbull, Rufus King, Gouverneur Morris, Jonathan Dayton, Elias Boudinot, William Bradford, James A. Bayard, John Marshall, Richard Henry Lee, C. C. Pinckney, and William Smith. The party began a new navy, but was prevented by the Democrats from going on with it. This ultimately killed the Federal party; unable to protect commerce by force, it had to do so by humiliating concessions to England, and thus become dependent on and an apologist for that country, which alienated public confidence. By 1796 it had become almost entirely a northern party. The French war afforded a chance of increasing the navy, which they did; but they committed the huge folly of passing the Alien and Sedition laws (q.v.), gratifying resentment at the expense of votes. Finally, when Adams took away their one issue by ending the French war (see Adams, John), the Hamilton wing broke with his, and the Democrats ousted the party in the elections of 1800. Its course in opposition deprives it of respect; when the Democrats almost at once dropped their original tenets, practically if not theoretically, and acted on those of the Federalists, the latter (as in the Louisiana Purchase, a pure Federalist measure) changed coats with the Democrats and fought them on their own discarded ground. Their best patriotic elements deserted them in swarms, and in 1804 they carried only Connecticut and Delaware and part of Maryland. But the Embargo (q.v.), and the selfish attempt of the agricultural sections to sacrifice the entire commerce of the country to their own supposed interests, temporarily reinforced the Federalists; in 1808 they had every New England State but Vermont (the only one with no seaboard), besides Delaware and parts of Maryland and North Carolina. The War of 1812 was so unpopular in the North that in the elections of that year New York and New Jersey went Federalist also, and Maryland solid; and the balance of power was held by the three backwoods States of Kentucky, Tennessee, and Ohio,—or by Pennsylvania, whose agricultural west had now swamped the Philadelphia region. But the party as such was really dead; half the old leaders were gone, several of the others had turned Democrat or Independent, Marshall was imbedding its best principles in the national system from the Supreme bench; the chief men now were King and Pinckney. When the war closed, the issue on which the commercial sections had joined them was closed and these at once deserted the party; the Hartford Convention (q.v.) had driven all the remaining leaders out of public life with the stigma of secession and treason; and in 1816 the party carried only Massachusetts, Connecticut, and Delaware, with three Maryland electors who would not vote. The scattered Federalists in Congress did not act as a party, having no issues even as a pretense, and as a national party it ceased to exist. Statewise, it controlled Connecticut and Delaware till after 1820, and Massachusetts till 1823, when the Democrats swept even Essex County from the «Junto.» It lingered for some time also in Maryland and North Carolina.

Federals, the name given to those who during the Civil War in the United States fought to maintain the Union of the Federal States, as opposed to the Confederates.

Federation of Labor. See AMERICAN FEDERATION OF LABOR.

Federmann, Nikolaus, nē'kō-lous fā'dĕr-män, German explorer: b. Ulm, Swabia, 1501; d. about 1542. He was sent to Venezuela by the Welsers of Augsburg, becoming chief lieutenant of Alfinger, and making explorations into the interior of the country. He returned to Europe 1532, going back to Venezuela 1534, as the lieutenant of George of Speyer. He did not follow the latter on one of his expeditions, as ordered, but made an independent exploration with 200 men, spending some years in the valley of the Orinoco, and reaching New Grenada in 1539, where he met Gonzulo Kuesada, already in possession, and relinquished the region to him. Federmann returned again to Augsburg, but was discharged by the Welsers for misfeasance. His account of his first exploration was published in German, 'Indianische Historia,' 1557, and in French 1837.

Fee, John G., American abolitionist: b. Bracken County, Ky., 9 Sept. 1816; d. Berea, Ky., 12 Jan. 1901. He entered the Lane Theological Seminary, Cincinnati, Ohio, in 1842, and soon afterward began to preach against slavery. As a result he was mobbed several times, but in 1853 went to Berea, Ky., where he succeeded in founding a church and establishing Berea College (q.v.), an institution open alike to blacks and whites.

Fee, Fief, or **Feudum,** is a legal term of feudal origin, signifying an inheritable estate in land, held by some superior, or lord; as distinguished from *allodium*, which is land held by absolute ownership. In the United States, however, where land is generally held in allodium, the private ownership is termed the *fee*, if subject to no paramount right except that of the State. In England the legal theory is that all the lands of the kingdom, except the royal domains, are held in fee, or by a tenure, of some superior lord, the absolute or allodial property being only in the sovereign, so that all the tenures are strictly feudal. This was a significant doctrine while the feudal system flourished in Europe; and the remnants of it are still blended, in a greater or less degree, in the land titles, or rather as a theoretical doctrine, from which certain inferences are drawn, than a plain, direct, practical fact; for the property of a proprietor in land held in *fee simple*, in England, is as absolute, to all intents and purposes, as where the land titles are allodial, there being no practical or theoretical doctrine of a tenure, or holding under a superior. *Fee tail* is any fee granted upon condition; or a fee limited to any particular heir or class of heirs; a qualified fee as differing from fee simple.

Fee Simple, an inherited estate belonging to the owner, his heirs and assigns forever. This is the most complete and exclusive interest that the possessor of lands can have in them, and the word continued to be employed in real estate law after the feudal system had passed away. This is the case even in the United States, where land is generally held in allodium (q.v.) and subject to no paramount claim excepting that of the eminent domain which belongs to the State.

Fee Tail, an estate limited to a certain line of descent, to certain heirs or to a certain class of heirs; sometimes known as a conditional fee.

Feeble-minded, Education of. The term feeble-minded is now used to embrace all classes and grades of the mentally defective, excepting the insane, who, properly speaking, are mentally sick. Idiocy was the term formerly used to cover the same range. Idiocy or feeble-mindedness may be defined as «mental deficiency depending upon imperfect development, or disease of the nervous system, occurring before, at, or after birth, previous to the evolution of the mental faculties.» At the time the feeble-minded were first taught, it was supposed that their growth of body and mind, which was seen to be but partial, had simply been stopped by malign influences, and that in many cases all that was needed was proper environment in order to start the growth again; it was hoped that the improvable cases at least could be educated and trained to approach in capacity the normal-minded individual. The first attempts to train the feeble-minded in this country were made in 1848. Before that time idiots who were not kept at home were to be found in almshouses or in insane asylums. Kind-hearted physicians who saw this «rubbish of humanity» cowering in terror before lunatics or abused by almshouse associates, agitated for their relief, care, and training. The movement began in New York and Massachusetts in the year 1846. In the latter State the legislature appointed a commission to report upon the number, condition, and the best means of relieving the idiots in the commonwealth. Dr. Samuel G. Howe, the director of the Perkins Institution for the blind, was made chairman. The report made in 1848, and widely known as «Dr. Howe's report on idiocy,» was exhaustive, and ended by recommending the opening of an experimental school. One was opened at the expense of the State and under the guidance of Dr. Howe himself. The results were so favorable that in three years' time the State doubled its appropriation, and founded in South Boston the Massachusetts School for Idiots, the first State school for them. The State of New York followed, establishing its school similarly, or experimentally, in 1851, and permanently in 1853. Between the appointment of the Massachusetts commission and its report, a country physician, Dr. H. B. Wilbur, had opened a small private school for idiots at Barre, Mass., really the first school of its kind in America. Dr. Wilbur was soon called to take charge of the New York State school. The Pennsylvania school followed in 1852, and was established in Philadelphia as a private corporation in 1853; then in 1857 came the Ohio State institution at Columbus; in 1858 the semi-public school in Lakeville, Conn.; the Kentucky State school at Frankfort in 1860; the Illinois State school in 1865; the Hillside home, a private school at Fayville, Mass., in 1870. «Thus up to 1874, 26 years after this work was begun in America, public institutions for the feeble-minded had been established in seven States. These institutions then had under training a total of 1,041 pupils. There were also two private institutions in Massachusetts, with a total of 69 inmates.» Applications for admittance were numerous and pressing. At first it was the theory that only imbeciles, the improvable idiots, should be taken into the institution, that the institution should be a school and should graduate its pupils into the world. But most of the superintendents soon recognized that the pupils would always be children though adult in years; that they needed guidance and protection always; that for obvious reasons girls and women of child-bearing age should not be discharged — for no girl is so exposed as the simple, weak-willed, feeble-minded girl — and finally that practically all cases would have to be retained within the institution. Physiology and pathology now teach that «mental deficiency generally, if not always, is the result of a definite cerebral abnormality or defect, or the result of actual disease or damage to some part of the central nervous system»; that feeble-mindedness is practically a permanent condition, and that it cannot be cured. From the time this fact came to be realized the institutions began to change in character. There arose two distinct departments — the training school and the asylum.

The school is the fundamentally important department. Education is just as much a right of the improvable imbecile as it is of any child. The aim in the education of an ordinary child is to give a liberal all-round training, fitting him for anything in life he may choose to take up. With our feeble-minded child the aim of his education, which is to lead a useful life within the institution, is kept ever in mind. He is happiest when occupied. Hence his education is principally practical. The difference between a normal person and a feeble-minded person after training is that the latter has no initiative, no power to resist the seduction of stronger minds. He may be useful and even self-supporting, but he can become so only under guidance and direction. When they come to school these children have extremely weak will power. In fact, the feeble-minded as a class have been divided by Sollier according to the attention, thus:

«1. Absolute idiocy. Complete absence and impossibility of attention.

«2. Simple idiocy. Attention feeble and difficult.

«3. Imbecility. Instability of attention.»

With all these the condition of the hand indicates that of the brain. The «idiotic hand» is proverbial. Many imbeciles see but do not perceive; hear but do not understand. They rarely make a purposive effort, but need to be directed in everything. When it is comprehended that though they love games they do not even play of their own accord, it will be understood how their teachers must begin at the very bottom rung in the ladder of education. The special senses of seeing, hearing, and feeling, actually have to be aroused and developed, (1) as simple physiological functions; (2) as intellectual faculties. Callisthenics in classes, marching to music, military drill — movements and exercises of all kinds — exert a most salutary and energizing influence, and are in great use in all the schools. The normal child does not need to be taught each step; his power of attention, his will, his desire, his originality enable him to fill the gaps in instruction from his own daily experiences. On the contrary, the feeble-minded child has to be taught each step, hence, his education is extremely slow. The simple occupations of the kindergarten fit these children of 8 to 12 years of age as they do bright children of 4 and 5. The teacher devises all manner of busy work for them, generally using coarse materials; the stringing of spools; beads; buttons; spool-knitting; plain knitting; braiding with broad leather strips, with shoe-strings, with straw; and block building from the simple cube to the forms that are more complex. No instruction is in more general use and is more helpful to the children than that of the kindergarten. After this all their education continues on a very elementary plane beyond which it is impossible for them to go. Many learn reading, writing, and arithmetic. The brightest read simple stories with pleasure, and go as far in arithmetic as multiplication. Division is beyond them. Calculation in the abstract they cannot master. The greater part of their education is, therefore, of a purely practical kind. They are taught a good deal of fancy work, like knitting, crocheting, embroidery, and lace-making; but chiefly domestic work, sewing, washing and ironing, baking, farming, house-painting, shoemaking, brushmaking, etc. Entertainments are very frequent at these institutions, and the «men and women children» are always present. No discrimination as to age or capacity is permitted, and happiness prevails. The institution is a small community. It must have a given number of employees, one or more to each section or department. But the stronger grown up children do the bulk of the work: baking, laundry work, shoemaking, sewing, mending, dressmaking, and tailoring. Each institution aims to have as many acres of land as it has children, and on the grounds a barn, cattle, horses, and all the paraphernalia of a farm. This farm is worked by the boys. By utilizing the energies of the pupils in profitable labor the average per capita expense may be reduced to $125 or $150 a year. Supt. Doren of the Columbus institution has said that if the State will provide him 1,000 acres of good land he will care for all the custodial cases in Ohio free of expense to the State. When an old school has moved to a new site as the Massachusetts school has recently done, the labor of the boys has been utilized in clearing the land and ditching it, in building the roads, etc. Where the grounds contain suitable clay soil, as at Fort Wayne, Ind., the boys have made the bricks with which to build new structures as needed. But in all this care is taken that there is no overwork. The work of an average laboring man more than supports himself — it is generally reckoned to support three people. If the feeble-minded man does one half or one third of a man's work, and does it every day, his support costs only that which will pay for his superintendence and care. The lowest cases of the unimprovable idiots, whom nearly all the institutions have been forced to admit, are termed the «custodial cases,» and are kept by themselves. They are profoundly helpless, can neither speak nor attend to their bodily wants, but must be cared for like babies, which they are. Attendants willing to do this work are not easily found. But trained feeble-minded girls are delighted and flattered at the privilege of taking care of those more helpless than themselves. And it has been found that they make the best attendants for such cases. So far, then, as methods of instruction go, American teachers have but broadened the physiological methods of the Frenchman, Seguin. The distinctive results of our schools lie in training the pupils to be helpful, especially in the way of labor for these institutions.

A distinctive result of work for the feeble-minded has been the gathering of statistics of causes. It has been known that a very large percentage of cases, variously estimated from 50 per cent to 70 per cent, are of congenital origin; that of all classes of defectives the feeble-minded most surely tend to transmit their defect; hence, that the feeble-minded must be sequestrated for life. It has been shown that there is a strange but strong correlation between the forms of degeneracy, namely, the criminal, the inebriate, the prostitute, and the feeble-minded. Of late years the energies of charitable and sociologic organizations «have turned toward combating the causes of degeneracy, thereby protecting posterity.» The United States census for 1890 gives in round numbers 95,000 feeble-minded, and this number is undoubtedly short of the actual number. Still but one twelfth or about 8,000 of those returned in the census are cared for in special institutions. Here is a terrible problem ahead for the sociologists to work out. Those who have most thoroughly studied the feeble-minded are convinced that, as prevention is cheaper than cure, so the gathering of all this vast army into institutions and especially colonies where 50 per cent of them can be taught to be at least partly self-supporting, and where their multiplication can be cut off, is, by all odds, the most economical and the best policy for the States to pursue in the future. It should not be forgotten that for every idiot cared for we restore at least one productive person to the community. The matter is receiving widespread and intelligent attention. The work for the feeble-minded is considered by those in it as being still in a tentative stage. Nearly all the superintendents are physicians; they do not agree on the different questions involved. They meet regularly in convention, and have an organ of communication, called ‹The Journal of Psycho-asthenics.› As the methods of teaching the feeble-minded and the other defective classes have become understood, they have modified the old methods of teaching children of normal intelligence. Child study is now interesting teachers, and already has led to the sending of many feeble-minded children to special schools for their training. The city of Providence, R. I., has recently led the way in a new movement, that of teaching in special classes the dull or backward pupils of the public schools. The movement is slowly spreading elsewhere, and, in justice both to the dull and the bright children, is of inestimable value, and, as such, is a hopeful sign of the times.

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Feed Pump, a force-pump, for supplying the boiler with water.

Feeder, (1) a stream, fountain, or channel which feeds or supplies a main stream or canal with water. (2) A branch or side railway, intended to bring traffic to the main line. (3) In hydraulic engineering, a feeder is a water-course, natural or artificial, carrying water to a canal or reservoir. (4) In mining, the side branch of a vein which passes into a lode. (5) In sewing-machines, that part which carries the cloth along the length of a stitch between each penetration of the needle. (6) In machinery, an auxiliary or supplying part of a machine, that which leads along the stuff being operated on. (7) In iron founding, a head or supply of fluid iron to a runner or mold in heavy castings. (8) In nail-making, a contrivance with an intermittent oscillating or semi-rotary and forward motion to present the plate to the cutters, so that the head of the nail may be taken from the respective edges alternately. (9) In printing, a device with fingers which take the top sheet from a pile and lead it into the press where it is printed or folded. (10) In steam engineering, a device for supplying steam boilers with water in quantities as required. Automatic boiler-feeders act by means of floats on the surface of the water in the boilers. (11) In threshing, the grain-feeder, which forwards the opened sheaves into the throat of the thresher, or the grain into the eye of the millstone, or the grain and chaff from the hopper to the riddle of a winnowing machine, or the grain from the bin to the manger of sheep or other stock. (12) In electricity, a lead in an electric central station distribution system, which lead runs from the station to some point in the district to supply current.

Feeding, Forced, a mode of putting food into the body of persons who are incapable of feeding themselves, or who refuse to take food. In many protracted diseases, such as typhoid and pneumonia; in certain stages of tuberculosis; in cancer of the stomach; in ulcer of the stomach, and in other conditions, it may be impossible for the patient to hold food in the stomach. Under such circumstances feeding by rectum may be practised. (See NUTRIENT ENEMATA.) Forced feeding more properly applies to the giving of nourishment to those who are suffering from one of the insanities, and by reason of their disease refuse food. They may be fed either through the stomach-pump or by means of rectal enemata, the former being the method to be preferred. In this the physician passes a soft rubber tube through the nose into the œsophagus and stomach, care being taken that the tube does not pass into the larynx.

Through the tube, then, either by means of a Davidson syringe or through a funnel, the food, usually milk, is passed. Insane people rarely attempt to vomit their food after it has been once passed in this way, although many refuse to take it and swallow it in the ordinary manner. If forced feeding by way of the rectum is necessary, nutrient enemata (q.v.) may be employed.

Feeding Machine. By this name are commonly known the machines used to automatically supply printing-presses or the like with paper sheets. Printing of a high grade is not done on the great web printing machines, which feed from a roll of paper. Those are built for speed, but for fine printing presses of the single cylinder type, using single sheets of paper are almost universally used. Such presses were always fed by hand until about 1895, when the first practical paper-feeding machines for printing-presses began to come into use. The first of these machines to secure a considerable sale was the Economic feeder, made by E. C. Fuller & Company of New York. In its latest form the Economic feeder is attached at the rear of a cylinder printing machine, and lifts a sheet of paper from the top of a pile by first buckling the two rear corners, then blowing air under the buckled sheet to separate it wholly from the rest of the pile, after which the sheet is advanced or pushed forward to the guides of the press by means of rubbers and traveling endless tapes. The pile of paper from which the sheets are fed is placed on a platform that is arranged with mechanism for raising it very slowly, so that the top of the pile is always kept at substantially the same level. The perfecting of these machines has been obtained only after very costly experimenting, and the addition of improvements as defects were found. Paper piled in sheets has a tendency to stick together, in fact, sheets are sometimes actually glued in spots, as by the crushing of an insect between them. The automatic feeding machine has to provide for such contingencies, and when a torn sheet is found, or a wrinkled one, or two sheets stuck together, the feeder must not only be stopped, but the printing-press also must be brought quickly to a standstill or damage results. Ingenious automatic devices have been introduced for controlling these conditions, and the machines are now commonly used in connection with the printing of magazines of large circulation, some of the larger magazine and book printers employing as many as 30 or more feeding machines in one establishment. The Economic machines will accommodate 10,000 to 20,000 sheets of paper at a single loading, which saves the time formerly lost by the hand feeder about once in 1,000 sheets, in stopping to put up another pile. There is also a saving in soiled sheets, in wages paid, and often in the speed at which the printing-press can be run. The Economic feeder is built in a slightly different form for use with paper-folding machines and with paper-ruling machines. See FOLDING MACHINE.

The Dexter feeding machine was introduced in New York about 1900. Its general characteristics resemble the Economic, but the details of mechanism are different. Dexter was the first to introduce a machine driven by floor connections, which secures greater rigidity than when driven by a chain from the cylinder of the press. Non-electrical devices are employed throughout, some of the most ingenious being the devices for calipering the sheet, to make sure that two sheets do not go into the press together, and the controlling apparatus for tripping the impression of the printing cylinder if a sheet is missed or fails to come down properly to the guides. The Dexter Company also builds folding machines, and their feeders are adapted to use with these, as well as for ruling machines.

The Cross paper-feeder, made by the American Paper Feeder Company of Boston, does not occupy any floor space, as do those previously described, being located above the feed-board of the press. It accommodates several hundred sheets at a time, and reloading is accomplished without stopping the press. It requires no adjustments for quality or weight of paper, and is practical for short as well as long runs. The sheets of the pile are combed out, then turned completely over and reversed in direction, and guided one by one to the feed-guides of the press. The Harris printing-press, a small rotary machine for envelopes, cards, etc., employs a feeding mechanism that should be mentioned in this connection. It automatically picks an envelope or card from the bottom of a pile and carries it into the press. The attendant loads on more cards or envelopes without stopping the machine. See PRINTING; AMERICAN PRINTING TRADE.

Feed-water Heaters, in steam engineering, are devices in which feed-water is heated to a certain extent, before it is introduced into a steam boiler. If cold water is fed into a hot boiler, its chilling action upon the plates and other metal parts causes them to undergo a powerful contraction, which often strains the structure so that leakage occurs about the riveted joints, tube ends, and other places where the parts of the boiler are secured to one another. If the water is heated as nearly as practicable to the temperature prevailing within the boiler, these contraction strains are in large measure avoided, and the life of the boiler is correspondingly prolonged. Furthermore, many feed-waters contain compounds of lime in solution, which are in large measure precipitated by the action of heat. If such a water is fed into the boiler cold, these compounds are thrown down within the boiler, where they form a most troublesome scale, sometimes of stony hardness, upon the heating surfaces. When a heater is used, these objectionable matters are precipitated in the heater itself, which should be so designed that it can be periodically opened and cleaned. (See SCALE.) Another highly important feature of the feed-water heater is that it enables the engineer to utilize a considerable quantity of heat that would otherwise be wasted. When (as is often the case in certain localities) it is impossible to avoid the use of a feed-water highly charged with lime, the primary object in using the heater may be to effect the removal of the lime, as explained above; and in this case the heating is often effected, wholly or in part, by live steam drawn directly from the boiler, because in this way it is possible to attain a higher temperature, and a consequently more perfect precipitation. In other cases, however, it is usual to effect the heating either by means of exhaust steam, or by the hot gaseous products of combustion as they pass from the boiler to the chimney or stack. When the hot flue gases are utilized for this purpose, the heater is commonly called an «economizer,» and usually consists of a series of tubes through which the water to be heated circulates, these being placed in a chamber which the flue gases are obliged to traverse on their way to the chimney. Flue-heaters, or «economizers,» are very common in England, but they are not generally met with in the United States, although their use in this country is increasing. The exhaust-steam heaters are divided into two general classes, known respectively as «closed heaters» and «open heaters.» In the closed heater the exhaust steam from the engine is caused to flow through a series of tubes which are surrounded by the water to be heated, the steam giving up its heat to the water through the walls of the tubes in such a manner that the vapor and liquid never come into contact with each other. In open heaters, on the other hand, the steam and the water to be heated are brought into intimate contact with each other in a chamber or tank, into which the water is introduced in the form of thin sheets or spray. High feed-water temperatures are attained more readily in open heaters than in closed ones, and for this reason the open form is much used when the removal of scale-forming matter from the water is the chief object in view. On the other hand, exhaust steam is apt to carry over considerable quantities of oil from the engine, and when an open heater is used this oil mingles with the feed-water and so is introduced into the boiler, where it is likely to give trouble by adhering to the heating surfaces and causing them to become overheated and burned or bulged.

Fee'han, Patrick Augustine, American Roman Catholic prelate: b. Tipperary, Ireland, 29 Aug. 1829; d. Chicago, Ill., 12 July 1902. He was graduated from Maynooth College, Ireland, came to the United States in 1852, when he was ordained; and soon after became president of the Seminary of Carondelet. He had charge of St. John's Church, St. Michael's, and the Church of the Immaculate Conception, all in St. Louis, till 1865, when he became bishop of Nashville; and was installed as first archbishop of Chicago in 1880. During his administration as archbishop he founded several new parishes, a college of the Christian Brothers and other institutions.

Feejee Islands. See Fiji Islands.

Feeling, the sense of touch, emotion. See Emotion; Psychology.

Feer-Herzog, Karl, kärl fār-hĕr'tsoʜ, Swiss statesman: b. Rixheim, Alsace, 2 Oct. 1820; d. Aarau 16 Jan. 1880. He became a member of the Grand Council 1852 and was twice its president. In 1865 he was made Swiss representative in the Latin Monetary Union, which position he held for the rest of his life. He was director of the Swiss department of the Paris Exposition 1867, and for many years was president of the Swiss Financial Commission. Among his works are: ‹Unification monétaire international› (1869); ‹La France et ses allies monétaires› (1870); ‹Gold oder Silber?› the latter in German (1874).

Feet Washing, or **Washing of Feet,** a religious ceremony observed in the Roman Catholic Church, on Holy Thursday or the Thursday before Good Friday. This ceremony takes place just after everything has been removed from the altar. The pastor or principal prelate of the church washes the feet of 12 men, in imitation of the action of Jesus Christ, when he washed the feet of the apostles. The Pope washes the feet of 13 priests. The ceremony is sometimes called «Mandatum» from the first word of the antiphon sung during the ceremony: «Mandatum novum,» etc.: «A new commandment I give unto you that you love one another.» This custom, although mentioned in the Council of Toledo (694), is not now generally recognized.

Fehling, Hermann, hĕr'män fā'ling, German chemist: b. Lübeck, Germany, 9 June 1811; d. 2 July 1885. He studied chemistry in Heidelberg, at Giessen in Liebig's laboratory and at Paris. He became professor of chemistry in the Polytechnic School at Stuttgart, and professor emeritus in 1882. He had great authority in the educational and manufacturing circles of his time, as a teacher and prescriber of chemical formulæ for commercial products, such as sugar, and mineral waters. The so-called Fehling's' Solution (q.v.) is famous. He wrote: ‹Text-book of Organic Chemistry›; translated Payen's ‹Précis de Chimie Industrielle,› and edited a new edition of ‹Glossary of Chemical Terms.›

Fehling's Solution, a solution much used by chemists for the detection and estimation of glucose and certain other sugars. In its preparation, 34.64 grams of pure sulphate of copper crystals are dissolved in 200 grams of distilled water, and (separately) 173 grams of crystallized neutral tartrate of sodium are also dissolved in 500 or 600 grams of a solution of caustic soda having a specific gravity of 1.12. The copper solution is then gradually added to the caustic soda solution, and the mixed liquid is diluted to one litre. Fehling's solution must be freshly prepared, for, like all other copper test solutions, it becomes unreliable in a short time, thereafter indicating sugar where none exists. For use, a small quantity of the solution is placed in a test tube and diluted with about four times its bulk of water. It is then boiled for a few seconds, and if it remains clear, it may be considered to be in good condition. The fluid to be tested is then immediately added, drop by drop, until a bulk equal to that of the diluted test fluid has been added. If glucose is present a yellow precipitate of hydrated cuprous oxid is thrown down, which subsequently loses its water of hydration and becomes reduced to ordinary red cuprous oxid. When prepared as described above, one cubic centimetre of the standard (undiluted) solution corresponds to five milligrams of glucose. Fehling's solution is of a deep blue color, and in testing a complicated organic fluid (such as urine) for glucose it often happens that the test solution is decolorized even when no glucose is present. It is, therefore, important to observe whether or not an actual precipitate is formed, as mere decolorization is not a sufficient indication. Cane-sugar does not reduce Fehling's solution in the cold, but it does so when warmed, because heat changes cane-sugar to a mixture of glucose and fructose in the presence of the alkali that the test solution contains. See Pavy's Solution; Urinary Analysis.

Fehmarn. See Femern.

Fehmgerichte. See Vehmgerichte.

Feia (fā'yạ) **Lake,** in the province of Rio de Janeiro, in Brazil, near the coast. Area, 192 square miles. Connections by canals have been made with the Parahyba River on the north and the Atlantic on the east.

Feigned Disease. See Hysteria.

Feijo, or **Feijoo, Diogo Antonio,** dē-o'go ăṅ-to'nē-ō fā zho', Brazilian statesman: b. São Paulo, Brazil, 1784; d. 1843. As a priest he did pastoral work for many years, and in 1822 was elected to the Cortes, Lisbon, Portugal. When Brazilian independence was won he returned to America; in 1826 was chosen by the Liberal party as their deputy and representative, and introduced measures for municipal reform and the abolition of clerical celibacy. He served as minister of justice 1831–2, but in 1837 he retired from politics, before the storm of Conservative opposition which his liberal policy had called up.

Feisi, Abul Feis ibn Mubárak, ä'bool fā ēs ibn moo-bä'räk fī'sî or fā-ē-sē', Indo-Persian poet and scholar: b. Agra, India, 1547; d. there 1595. He surpassed all his contemporaries in philological, philosophical, historical, and medical knowledge, and about 1572 was crowned «king of poesy» in the court of the Emperor Akbar. Of his poems the most noteworthy are his lyrics — odes, encomia, elegies, and specially his four-line pieces or apothegms. Their exalted pantheism brought on him the enmity of the orthodox Moslem clergy. He wrote also many double-rhymed poems; and a Persian imitation of the famous Indian epic: ‘Nala and Damajanti,’ designed to form the third member of an epic cycle of which the first was to be ‘The Centre of the Circle,’ the second ‘Solomon and Balkis’ (the Queen of Sheba), the fourth ‘The Seven Zones of the Earth,’ and the fifth ‘The History of Akbar’; only the first and third were completed. His scientific treatises were numerous.

Feith, fīt, **Rhijnvis,** Dutch poet: b. Zwoll, Over-Yssel, 7 Feb. 1753; d. there 8 Feb. 1824. He was made burgomaster, and afterward receiver at the admiralty college in Zwoll, but did not cease to cultivate the art of poetry, and to enrich Dutch literature. He tried his powers in almost every department of poetry. In his earlier years he was too much inclined to the pensive and sentimental style. It predominates particularly in his romance ‘Ferdinand and Constantia’ (1785), and, through his example, has for a long time prevailed in Holland. His ‘Grave’ (Het Graf, 1792) is the first distinguished didactic poem since the revival of Dutch poetry. His ‘Old Age’ (De Ouderdom) appeared 1802. Among his lyric poems, ‘Oden en Gedichten’ (1798), are several hymns and odes distinguished for great elevation and feeling. His ode on ‘Ruyter’ is very celebrated. He also made that naval hero the subject of an epic poem. The best of his tragedies are: ‘Thirza’; ‘Johanna Gray’; and particularly ‘Inès de Castro.’ His poetical ‘Letters to Sophia on Kant's Philosophy’ (Brieven aan Sophie over de Kantiaansche Wijsbegeerte, Amsterdam, 1805) are a feeble effort of his old age. Among his prose works, his ‘Letters on Different Subjects of Literature’ (1784), contributed much to the dissemination of good taste, by their finished style and excellent criticisms.

Felch, Alpheus, American lawyer and politician: b. Limerick, York County, Maine, 28 Sept. 1806; d. 1896. He was graduated at Bowdoin College 1827, was admitted to the bar and practised law in Michigan, being elected to the legislature of that State 1836, and appointed bank commissioner 1838–9. He was judge of the Supreme Court 1842–45; governor of Michigan 1846–7; and United States senator 1847–53; he was appointed professor of law in Michigan University in 1879, holding that position till 1883.

Feldmann, Leopold, lā'ō-pōlt feld'män, German dramatist: b. Munich, Bavaria, 22 May 1802; d. Vienna 26 March 1882. In 1835 appeared his ‘Lays of Hell’; next the comedy ‘The Son on His Travels,’ which made a brilliant success at Munich. After five years in travel, chiefly in Greece, as correspondent of the ‘Allgemeine Zeitung,’ in 1850 he settled in Vienna for life. His comedies were very popular in their day. Among them are: ‘Free Choice’; ‘Sweetheart's Portrait’; ‘The Late Countess’; ‘The Comptroller and His Daughter.’

Feldspars, the most important group of silicate minerals. They are characterized by monoclinic or closely related triclinic crystallization, the frequent occurrence of twin crystals, cleavage in two similar directions inclined at an angle of 90° or nearly 90°, a hardness of about 6, a specific gravity between 2.5 and 2.9, a light color, usually white, pale yellow or green, or flesh-red, a white streak and a low relief and low order of interference colors as seen in thin sections with the polarizing microscope. In composition the feldspars are all silicates of aluminum, combined in the different species with one or more of the common alkaline bases, potash, soda, or lime, or rarely baryta. Magnesium and iron are conspicuously absent.

Forms.— Feldspars occur in massive, granular, lamellar, cleavable, and compact forms, but crystals are very common. The monoclinic feldspars include orthoclase, or common feldspar, and the very rare barium feldspar, hyalophane. Triclinic feldspars include microcline, anorthoclase, and plagioclase or the feldspars of the albite-anorthite series, embracing albite, oligoclase, andesine, labradorite, and anorthite. Descriptions of these minerals appear as separate topics. The feldspar group presents a striking illustration of the approximation in angle to forms of higher symmetry coincident with a wide difference in habit. In orthoclase, for example, the common planes *n*, *y* approximate very closely to the cube; *q*, to the octahedron; *m*, *b*, *c*, *o* to the dodecahedron, and *z*, *x* to the trapezohedron. Feldspar crystals usually appear prismatic and are often tabular parallel to the clinopinacoid, *b*. Twins of most remarkable variety abound, the commonest of which are after the Carlsbad, Baveno, albite, and pericline laws (see Crystallography). Polysynthetic twinning is almost universal in the plagioclase feldspars, and, while best observed in thin sections with the polarizing microscope, it is often detected in large masses by the fine striations which so beautifully mark some of the cleavage faces of labradorite, oligoclase, or albite.

COMPOSITION AND PHYSICAL PROPERTIES OF FELDSPARS.

Mineral.	Formula.	SiO_2	Al_2O_3	CaO	Na_2O	K_2O	Hardness	Fusibility	Cleavage	Specific Gravity	Extinction on *c*	Extinction on *b*
Orthoclase	$KAlSi_3O_8$	64.7	18 4	......	......	16.9	6.-6.5	5.0	89°53′	2.57	0°	—3° to 7°
Microcline	$KAlSi_3O_8$	64.7	18 4	......	......	16.9	6.-6.5	5.0	89°30′	2.57	+15°30′	+5° to 6°
Albite ...	Ab = $NaAlSi_3O_8$	68 7	19.5	.....	11.8	......	6.-6.5	4.0	86°24′	2.62	+ 3°	+17°
Oligoclase	$Ab_3\ An_1$	62.0	24.0	5.3	8.7	......	6.-7.	3.5	86°8′	2.66	+ 1°	+4°
Andesine .	$Ab_1\ An_1$	55.6	28.3	10.4	5 7	......	5.-6.	3.5	86°14′	2.69	—5°	—17° to 21°
Labradorite	$Ab_1\ An_3$	49.3	32 6	15.3	2.8	......	5.-6.	3.0	86°4′	2.73	—14° to 25°	—28° to 32°
Anorthite	An = $CaAl_2Si_2O_8$	43.2	36.7	20.1	......	......	6.-6.5	5.0	85°50′	2.76	—36° to 42°	—37° to 43°

Optical Characters.— Orthoclase is optically negative, with the axial plane usually at right angles to the clinopinacoid, *b*; but sometimes it is parallel to *b* and always becomes so when the temperature is increased to 600° to 1,000° C., this change also being produced by pressure. Microcline is also optically negative and the axial plane is nearly perpendicular to the *b*-pinacoid. Among the plagioclase feldspars the position of the axial plane changes with the composition, there being a regular progression in its position in passing from albite to anorthite. Albite is optically positive, anorthite is negative, while in some andesine, lying midway between them, the axial angle is practically 90°. Microcline is distinguished from all the other feldspars by the characteristic "gridiron" structure which is exhibited by thin basal sections when viewed under the microscope in polarized light. This is due to polysynthetic twinning according to the albite and pericline laws. The plagioclase feldspars may usually be recognized in thin sections, between crossed nicols, by their characteristic polysynthetic twinning, which manifests itself by parallel bands alternately dark and light.

Composition.—Orthoclase, or potash feldspar, is a potassium-aluminum polysilicate, $K\ Al\ Si_3O_8$. This compound is dimorphous, microcline, having an identical composition. Sodium often in part replaces the potassium, making soda-orthoclase or soda-microcline. When the sodium largely predominates the mineral passes into anorthoclase $(Na,K)Al\ Si_3O_8$; when it excludes the potassium, the mineral is albite, $Na\ Al\ Si_3O_8$. Anorthite is a calcium-aluminum polysilicate, $Ca\ Al_2Si_2O_8$. Between it and albite lie various triclinic feldspars, which are regarded as isomorphous mixtures of albite and anorthite. In the table above, the symbol *Ab* is assigned to albite and *An* to anorthite, and the ratio of these albite and anorthite molecules present in these feldspars is thus shown. The variation of the proportions of the constituent molecules gives rise to innumerable varieties filling up the gaps between the typical species which thus graduate from one into another. The change in chemical composition is attended by a change in specific gravity, fusibility, crystal form, cleavage angle, and optical properties. The foregoing table shows the progressive changes, there being an increase in specific gravity from albite at one end to anorthite at the other, while the fusibility and hardness decrease toward the centre of the series and increase at each end.

Occurrence.— The feldspars are not only the most abundant of all rock-forming minerals, but also the most important from a scientific standpoint, since the present scheme of classification of igneous rocks is chiefly based on the identity of the contained feldspar (see ROCKS). Orthoclase is an essential constituent of granite, syenite, and porphyry, while it is also one of the constituents of gneiss and the other granitoid rocks. Its variety sanidine is the feldspar of trachyte and phonolite. Microcline occurs similarly and is not easily distinguished from orthoclase except by an optical examination, though its two prominent varieties, amazonstone and chesterlite, are quite distinct. Albite is an essential constituent of diorite and is one of the component minerals of many crystalline rocks, occurring associated with orthoclase and microcline in much granite and gneiss. Albitic granite is often the matrix of the rarer minerals, and especially of some of the gems. Oligoclase abounds in granite, syenite, gneiss, diorite, trachyte, andesite, and diabase, often being associated with orthoclase. Labradorite is an essential constituent of various basic, eruptive rocks, in which it is commonly associated with some member of the pyroxene or amphibole groups, as in norite, gabbro, diabase, and basalt. Anorthite occurs in gabbro, basalt, and porphyry.

Alteration.— The feldspars are often altered into other silicates such as talc, chlorite, or the zeolites, but much the most common change is the production of kaolin (see CLAY). Infiltrating waters containing carbon dioxide dissolve out the alkaline ingredients of the spar, which, entering into new combinations, form various secondary minerals, while the aluminum silicate becomes hydrated and forms kaolin. If the waters contain magnesium salts the feldspar may be altered to talc.

Uses.— Feldspar is extensively used in the manufacture of porcelain, serving as a flux to bind together the other constituents, clay and flint. It is also one of the principal ingredients in the glaze for chinaware and tiles, and it has less important applications in soap-making, polishing materials, and dentistry. The beautiful change of colors in labradorite has led to its use for table tops and inlaid work. The gem moonstone is a variety of feldspar, usually oligoclase.

Production.— The production of feldspar in the United States during 1902 amounted to 21,870 short tons of crude spar, valued at \$55,501, and 23,417 tons of ground spar, valued at $194,-923. The chief supply comes from Pennsylvania, Connecticut, New York, and Maine. Potash feldspar, that is, orthoclase or microcline, is the material most used. Although it is such an abundant rock constituent, it is comparatively rarely segregated sufficiently to be available for commercial uses. The quarries of greatest value are usually those in which the feldspar occurs in pegmatite dikes, in gneiss or mica schist. The larger masses of mica and quartz are broken and picked out by hand, but considerable percentages of quartz often remain, which, however, within reasonable limits, are not objectionable for pottery, since flint is always mixed with the spar in the process of manufacture. The quarries are nearly all worked by open pits, some of which are of mammoth size, one in Glastonbury, Conn., having produced 200,000 tons, another at Elam, Pa., 100,000 tons.

GEORGE LETCHWORTH ENGLISH,
Mineralogist, New York City.

Félegyháza, fā'ledy-hä-zo, or **Kiskun-Fé,** kish'koon'fĕ, Hungary, town about 65 miles southeast of Budapest. Agriculture and grazing are the principal occupations of the people of the surrounding country and the trade is in cattle, dairy, and agricultural products. Pop. 33,300.

Felicudi, fā-lē-coo'dē (ancient PHŒNICUSA), one of the Lipari Isles, off the north coast of Sicily, 10 miles west of Salina. It is about nine miles in circumference, has rugged cliffs of basalt, and three lofty summits, evidently produced by an extinct volcano. The soil is both fertile and well cultivated. Pop. 800.

Felidæ, fē'lĭ-dē, the cat family, which contains the most highly developed of the order *Carnivora.* The characters of the family are: the possession of a slender, extremely flexible body, of great muscular power; the limbs five-toed, the thumb of the anterior limbs not reaching the ground; the skull relatively short, the facial portion much shortened, very broad, and giving, by its capacious zygomatic arches, a rounded outline, and abundant space for the powerful muscles which move the lower jaw. The incisors are three in number on each side, above and below; the powerful canines are trenchant on both edges, and are sometimes grooved; the premolars are three above and two below, the molars one above and below — in all, 30 teeth. The premolars are laterally compressed, the third upper tooth, the carnassial, or sectorial premolar, having only a minute inner tubercle. All are digitigrade. The divisions, as given by Carus, are: Sub-genus 1. *Felis.* Claws retractile; limbs low; tail as long as the body. A. Old World forms. (a) Lions (*F. leo*). Color uniform; a mane. Africa and Western Asia. (b) Tigers (*F. tigris*). No mane; body striped. Whole of Asia, from the Altai and Amur to Java and the Caucasus. (c) Leopards (*F. pardus*). Large species, with spots or rings, and round pupils. Africa and South Asia. (d) Serval (*F. serval*). Small spotted species. South Africa. (e) Cats (*F. catus*). Small, not spotted, sometimes striped; pupils elliptic vertical. B. New World forms. (a) Leonine. Color uniform, no mane. Puma (*F. concolor*). (b) Leopard-like. Jaguar (*F. onca*). Sub-genus 2. *Cynailurus.* Claws not quite retractile. Hair on neck and between shoulders, long, manelike. Cheetah (*F. jubata*). Africa and South Asia. Sub-genus 3. *Lynx.* With ear-tufts and short tails. A. Old World forms. Caracal (*F. caracal*) and chaus. South Asia and Africa. B. New World forms. Canadian lynx (*F. canadensis*). Red cat (*F. fasciata*). Bay lynx (*F. rufus*) — all in North America. The family was represented in Tertiary times by the cave-tiger (*F. spelea*); an American species (*F. protopanther*); and an Indian (*F. cristata*). *Machairodus,* with its enormous sabre-like upper canine, ranged from Miocene to Pleistocene times in Europe.

In addition to this formidable apparatus of cutting-teeth, the tongue is covered with small recurved prickles by which they can clean from the bones of their prey every particle of flesh.

There are no quadrupeds in which the muscles of the jaws and limbs are more fully developed. The skeleton presents a light but well-built mechanism; the bones, though slender, are extremely compact; the trunk, having to contain the simple digestive apparatus requisite for the assimilation of highly organized animal food, is comparatively slender, and flattened at the sides. The muscular forces are thus enabled to carry the light body along by extensive bounds, and thus it is that the larger felines generally make their attack. The five toes of the fore-feet and the four toes of the hind-feet of cats are armed with very strong, hooked, sharp claws, which are preserved from being blunted by a peculiar arrangement of the phalanges. For this purpose the claw-joint of each toe is drawn back by ligaments attached to the penultimate joint, till it assumes habitually a perpendicular position, when the claw which it supports is completely retracted within a sort of sheath, and is entirely concealed by the fur. When, however, the animal springs on its prey, the tendons of the flexor muscles of the toes, overcoming the elasticity of the retractile ligaments, pull forward the claws, and they are ready to be buried in the flesh of the victim. The lower surface of the foot is furnished with thick ball-like pads of the epidermis, on which the animal walks; this gives them the noiseless tread peculiar to this family.

Members of the cat family hunt in the gloom, and, consequently, while escaping observation, require every ray of light that can be made available. The pupil is a long, vertical fissure; but this only obtains among the smaller genera; in all of the family above the ocelot in size, the pupil is round in form. On the top of the skull there runs a tolerably high bony crest, which reaches its greatest elevation at the very back of the head. This bone ridge is necessary for the attachment of the powerful muscles which operate the jaws and enable the cats to drag away their often very heavy prey.

In the digestive organs of the *Felidæ,* the salivary glands are small, and the stomach of a simple cylindrical form. The œsophagus opens at its anterior extremity, and the intestine commences from the posterior; so that everything favors a quick passage of the food, which receives no mastication, and is retained a very short time in the stomach. The intestine has no valves, is small in diameter, but muscular, and the whole canal, when compared with the length of the body, is extremely short, being as

3 or 5 to 1. In the domestic cat they are 5 to 1; but in the wild cat only as 3 to 1.

The *Felidæ* are now regarded as including only two genera, *Felis* and *Cynælurus*, the latter reserved for only one species, the chetah (q.v.).

Wild cats are found in all parts of the world except Australia, but principally in the warmer regions, where alone the larger species are met with.

In the caverns and river deposits of the Quaternary Period in Europe and America are found fossil remains of cats allied to or identical with living species. Such are the huge cave lion of Europe (*Felis leo,* race *Spelæa*) and others not so well known. During the Tertiary Period they were rare, their place being taken by the Machærodonts or sabre-tooth tigers (q.v.), animals similar to cats in many respects, but less agile, more powerful, and distinguished by enlarged sabre-like upper canine teeth, which indicate different habits of attack on their prey. The appearance of true cats, both in Europe and America, is correlated with the abundance of modern types of ruminants, etc.— slender, thin-skinned, long-necked, and swift-footed, in place of the powerful and heavily proportioned pachyderms common through most of the Tertiary Period. It is probable that both sabre-tooth tigers and true cats were evolved from the *Palæonictidæ,* a group of primitive carnivora or Creodonta (q.v.), in the early Eocene; but the proof from fossils is at present fragmentary and incomplete.

See CAT; COUGAR; LEOPARD; LYNX, and other names of wild cats.

Felix I., Saint, a citizen of Rome, reigned as pope from 269–74. He excommunicated Paul of Samosta, bishop of Antioch, for teaching that Christ was no more than a mere man. A portion of a treatise on the Incarnation, written by Felix I., is still extant. He was martyred (274) in the Aurelian persecution.

Felix II., Pope. He occupied the pontifical see during the banishment of Liberius, 355. In reply to a proposition for the recall of Liberius, it was proposed by the Emperor Constantius that Liberius and Felix should reign conjointly, but the people exclaimed: «One God, one Christ, one Pope.» Felix retired until after the death of Liberius (358) when he was recalled and became pope until he was martyred in the last of the 4th century. By many historians he is called an antipope.

Felix III., Pope, succeeded Simplicius in 483, and died in 492. Under him began the Acacian schism, headed by Acacius, Patriarch of Constantinople. Acacius was excommunicated by Felix III. at the Roman Synod of 484.

Felix IV., Pope from 526 to 530. He is noted for his promulgation of the 25 canons adopted by the Council of Orange (529) against Semi-Pelagians.

Felix V., an antipope: b. Savoy; d. Ripaille 1451. He is better known by his rightful name and titles, Amadeus, Duke of Savoy, Count of Geneva, and Cardinal. He was elected pope by the schismatical Council of Basel (1439), and in 1449 submitted to Nicholas V. who had been elected pope canonically. Felix V. is the last one of the antipopes.

Felix, Antonius, an-tō'nĭ-us fē'liks, Roman procurator of Judea. It was before him that Paul «reasoned of righteousness, temperance, and judgment to come.» Felix rose from slavery, having been manumitted by Claudius Cæsar. His rule in Judea, notwithstanding its severity or rather in consequence of it, was marked by constant disorders and disaffection; and but for the interest of his brother (the notorious freedman Pallas) with Nero, the charges carried up against him to Rome would have been his ruin. Drusilla, «the Jewess,» his second wife, had been seduced by him from her husband, Azizus, king of Emesa. Tacitus paints Felix in the darkest colors — a character confirmed by what is related of him in the New Testament, that he had expected a bribe from Paul, and that, disappointed in this, he left him bound, «to show the Jews a pleasure.» Acts xxiii., xxiv.

Felix, Eugen, oi-gān' fā'lĭks, Austrian painter: b. Vienna 27 April 1836. He studied art under Waldmuller in Vienna and under Cogniet in Paris, and settled in Vienna 1868. He painted religious and mythological subjects, studies of horses, portraits and interior scenes, among his canvases being: 'The First Friend'; 'Pan and the Bacchantes,' his portraits including those of Rubinstein, and Philip, Duke of Würtemberg.

Felix, Marcus Minucius, mar'cus min nu'-shĭ-us fē'liks, Roman lawyer: flourished about 230 A.D. He embraced Christianity, and wrote an excellent defense of it in a dialogue entitled 'Octavius.' The period when he flourished is uncertain, some making it as early as the reign of Marcus Aurelius, while others make it as late as that of Diocletian. The purity of the Latin style, and some of the allusions to the existing state of the Church, would seem to favor the earlier date; but it is not easy to set aside the direct testimony of Jerome, who, in a regular list of Christian writers, places him between Tertullian and Cyprian, thus fixing the period to about 230 A.D. The 'Octavius' has been translated into most European languages.

Felix Holt, the Radical, a novel by George Eliot (1866). It is a picture of upper middle-class and industrial English life of the period of the Reform Bill agitation.

Felix'ians, a Spanish sect of the later part of the 8th century, so called from Felix, bishop of Urgel.

Fell, John, English prelate: b. Longworth, Berkshire, 23 June 1625; d. 10 July 1686. He was graduated at Christ Church, Oxford, 1643, took up arms for the royal cause, and later, at the Restoration, became canon of Christ Church and dean 1660, becoming vice-chancellor of Oxford 1666, which office he held till 1669. He displayed much interest in the development of the University Press, and in 1675 he was appointed bishop of Oxford. Among his works are: 'The Interest of England Stated' (1659); 'The Life of Dr. Henry Hammond' (1661); 'Grammatica Rationis sive Institutiones Logicæ' (1673); 'The Vanity of Scoffing' (1674); and several editions of classical Latin and Greek authors. He was satirized in Tom Brown's famous epigram beginning «I do not like you, Doctor Fell.»

Fell (Norw. *fjeld,* Swed. *fjäll*), the name given in Scandinavia to the bare plateaus which occur in its mountainous regions; they are destitute of vegetation, and generally lie above the snow-line. The word enters as a component into the names of innumerable mountains, owing to the fact that in their formation they have taken on the shape of a fell. Fell is also used in the north of England and south of Scotland to designate a barren hill, and indicates Scandinavian settlements. See MIDDLESEX FELLS.

Fellahs, fel'a̤z, or **Fellahin,** fel'a̤-hēn, the people of Egypt who live in villages and cultivate the soil. The name signifies «tillers.» They form a large part of the population; are the most ancient race in that country, and are generally believed to be the descendants of the old Egyptians, their physiognomy resembling that which is found on the ancient sculptures. They are a patient and laborious population, and were heavily taxed before the period of English influence in the government. See EGYPT.

Fellatahs, fel-lä'täz, or **Fulahs,** foo'läz, native **Fulbe,** fool'bĕ, a remarkable race of the negro type, the original locality of which is unknown, but which is now widely diffused throughout the Sudan, where they form a kind of ruling aristocracy. The states or kingdoms of Senegal-Futa, Futa-Jallon, Haussa, Sokoto, etc., are in their hands, and they thus extend from Senegambia eastward to Lake Tchad. Though of the negro family, they differ widely in their physical characteristics from that race. In person they are decidedly handsome, and mostly of a light copper color. They have regular features, small mouths, and noses inclining to aquiline; silky hair, and fine black eyes; and are tall, well proportioned, and of erect and graceful figure. Some of the young women are very good-looking, and would be considered beautiful even in Europe. The Fellatahs are shrewd and intelligent; extremely active, polished, and insinuating in their manners, and said to possess great bravery and perseverance. They are not very much inclined to trade or agriculture, leaving these chiefly to the subject peoples. They are mostly Mohammedans, to which religion they became converts about 400 years ago. In the beginning of the 19th century they spread Islamism through the Sudan and established their dominion over a wide territory.

Fellenberg, Philipp Emanuel von, fĕ'lēp ā-mä'noo-el fon fel'len bĕrʜ, Swiss educational and agricultural reformer: b. Berne 27 June 1771; d. Hofwyl 21 Nov. 1844. The years 1795–8 were spent in traveling over France and Germany, visiting in preference the villages, and chiefly devoting his attention to the material, intellectual, and moral condition of the agricultural classes. He became convinced that the cause of all the existing poverty and misery was the absence of sound and rational instruction, and that the remedy lay in combining with a sound general education special training for the pupil's future trade. On his return to Berne he devoted himself to the improvement of the social and intellectual welfare of the peasantry. For this purpose he purchased the estate of Hofwyl, and established successively an institution for instructing the children of the poorer classes, a seminary for children in the higher grades of life, and a normal school. The pupils were all trained to work in the fields or at the bench, and the product of their labor was sufficient to cover the expenses of their education. Fellenberg's scheme was at first ridiculed by his countrymen, and looked upon for a time with some suspicion by the government; but ere long its beneficial results attracted even the attention of foreign governments. Alexander I. of Russia conferred upon the philanthropist the decoration of St. Vladimir, and sent seven young nobles to be educated at his institution. Several foreign princes visited the establishment, and founded institutions on a similar plan. The Fellenberg institutions still exist, though on a less extensive scale, and are partly carried on by his descendants.

Fell'ing, England, town, in Durham County, on the Tyne, two miles southeast of Newcastle. It has chemical works, forges, factories, and coal mines nearby. Pop. 22,460.

Fellows, SIR **Charles,** English traveler and antiquarian: b. Nottingham Aug. 1799; d. there 8 Nov. 1860. Without any claims to classical attainments, he collected unassisted a vast amount of material for the learned to labor upon. He first explored the valley of the Xanthus in Lycia, in 1838, and discovered the remains of the two cities Xanthus, the Lycian capital, and Teos. Under the auspices of the trustees of the British Museum he made further explorations in 1839 and 1841, and succeeded in obtaining the marbles now in the Lycian salon of the Museum. He was knighted by the queen in 1845. His principal works are: ‹The Xanthian›; ‹Travels and Researches in Asia Minor›; and ‹Coins of Ancient Lycia before the Reign of Alexander.›

Fellows, John, American author: b. Sheffield, Mass., 1760; d. New York 3 Jan. 1844. His publications include: ‹The Veil Removed› (1843); ‹Exposition of the Mysteries or Religious Dogmas and Customs of the Ancient Egyptians, Pythagoreans, and Druids›; ‹Mysteries of Free-Masonry›; and a work on the authorship of the Junius letters.

Fellowship, an institution or feature of ancient origin in certain European universities, but of recent introduction in the colleges and universities of the United States. In an English university the fellowship entitles the holder, a graduate, who generally is called a fellow, to participate in the revenues of a certain college, or to have the benefit of a special endowment, and also confers a right to rooms in the college, and certain other privileges, as to meals, etc. Fellowships are generally forfeited upon the attainment of a certain position in the church or at the bar, and are retained after marriage only by special vote of the college. With these exceptions, the tenure was formerly for life, but many fellowships have altered in this respect. In Cambridge the tenure is now limited to six years. Both resident and traveling fellowships are granted for work in a special line. Formerly the value of some of the fellowships at Oxford and Cambridge was equivalent to $2,500, and even $4,000, but great changes have been made in the number and emoluments of the fellows at both universities. At Cambridge there are in all about 400 fellowships, some of the colleges having as many as 50 or 60 attached to them. The average annual value is from $750 to $1,250. At Oxford there are now two classes of fellowships, ordinary and tutorial. The emoluments of an ordinary fellowship are $1,000 a year, those of a tutorial fellowship usually $1,500. New fellows are generally elected by the head of the college to which they belong and the fellows. There are also fellows connected with Dublin University, and in recent years a few have been attached to the Scotch universities. In American universities many fellowships have been established by private individuals, to promote research in special departments of knowledge. Fellowships are frequently awarded for study abroad, but others are for resident holders who, in some cases, give part of their time to instruction. Fellowships, unlike scholarships, are awarded to graduates only. The Johns Hopkins University first used the system extensively. The value of fellowships varies greatly. The most common amount is about $500 per annum, but in some cases the income is only $120 and in others it reaches $1,000. Chicago University has nearly 80 fellowships and several other institutions from 22 to 55 each. Annual fellowships may generally be reassigned more than once to the same holder, and there are fellowships with a tenure of several years. There are several fellowships at the American schools of classical studies in Athens and in Rome, open to graduates of American universities.

Felltham, or **Feltham,** fĕl'tham, **Owen,** English author: b. Mutford, Suffolk, probably 1602; d. Great Billing, Northamptonshire, 1668. He resided in the family of the Earl of Thomond, had strong royalist sympathies, was well known to the literary men of his time, and published a work of great merit, entitled: 'Resolves, Divine, Political, and Moral.' This book went through 12 editions by the year 1709.

Felo de se, fē'lo dē sē, from the mediæval Latin, felon or traitor to himself, is the legal technical description for a suicide. See SUICIDE.

Felony, in law, a term originally applied to those crimes which were punished by forfeiture of lands and goods, in addition to any other punishment prescribed by law. As so used it was distinguished from a *misdemeanor,* which was an offense that did not entail forfeiture as part of the penalty. The word cannot now be said to have any very definite meaning in law. It may be applied to crimes entailing capital punishment, as well as to others for which capital punishment is not inflicted; and is so applied by statute in the States of New York and Massachusetts. In many States the distinction between felony and misdemeanor has been abolished, an example that in time will probably be universally followed. Compounding a felony in refraining from prosecuting a felony for a consideration, constitutes a crime.

Fel'site. As a rock name, felsite is rather indefinite but is a very convenient name for those dense fine-grained igneous rocks, usually gray but often red or green, that to the naked eye show no crystals of minerals. Felsites generally are ancient lavas containing a high per cent of silica and are composed almost wholly of minute crystals of quartz and feldspar. The percentage of silica varies, and the relationship and probable origin of a felsite can be determined by analysis and examination with the microscope. Igneous rocks having a finely crystalline ground mass with visible crystals are said to have a felsitic ground mass, thus petrographers speak of felsite-porphyry. See ROCK; RHYOLITE; TRACHYTE

Felt, Joseph Barlow, American historian: b. Salem, Mass., 22 Dec. 1789; d. there 8 Sept. 1869. He was graduated at Dartmouth College 1813, and was ordained Congregationalist minister, having churches in Sharon, Mass., and Hamilton, Mass. In 1836 he was appointed to classify the Colonial and State archives of Massachusetts. His 10 years' work at this task was invaluable to the State. Among his works are: 'Annals of Salem' (1827); 'History of Ipswich, Essex and Hamilton' (1833); 'Historical Account of Massachusetts Currency' (1839); 'Ecclesiastical History of New England' (1855–62); and 'Collections for the American Statistical Association on Towns, Population, and Taxation' (1847).

Felt, from Dutch *vilt,* a fabric made from wool, or wool and hair or fur, by rolling, beating, and pressure, generally with the use of lees or size. The process of felting is similar to that of fulling. The fibres of fur, hair, or wool are rough in one direction only, and thus they can glide among each other in such a way that when the mass is agitated the anterior extremities slide forward in advance of the body, or posterior half of the hair, and serve to entangle and contract the whole mass together. Articles of felt, such as rugs, carpets, clothing, and hats, have been made from remote antiquity, and are still made and widely used among various Asiatic peoples. Legend ascribes the invention of felt to St. Clement, who found that carded wool, placed in his shoes to protect his feet while on a pilgrimage, worked into a felt by the pressure and moisture; but it has a much earlier origin, being apparently known in Homer's time. The Saracens used it for tents and it was probably introduced into Europe at the time of the crusades. In Europe and America felt cloths are also made for several purposes, the finer kinds especially for carpets and table-covers, which may be dyed or printed and finished in various ways. In the machinery by which felt fabrics are produced, rollers with a rubbing and oscillating movement have generally an important action. The materials commonly used for felt hats are the furs of the rabbit and other animals, and the wool of sheep. The latter material is employed for common and medium hats, only the finer felt hats being made from fur. The hats, after being stiffened, are dyed. They now undergo the operation of blocking in order to give them their proper shape. Coarse varieties of felt are used for covering steam boilers and cylinders, steam-pipes, and otherwise as non-conductors. Asphalted felt is a coarse felt saturated with pitch, asphalt, or coal-tar, and used for covering sheds and other buildings, and a superior kind called inodorous felt is used for lining damp walls. Another kind is asbestos felt. See HAT.

Felton, Cornelius Conway, American classical scholar: b. Newbury, Mass., 6 Nov. 1807; d. Chester, Pa., 26 Feb. 1862. In 1834 he became professor of Greek literature at Harvard; in 1860 its president. His publications include many translations from German, French, and Greek, of which 'The Clouds' and 'The Birds' of Aristophanes are the most distinguished; also 'Familiar Letters from Europe' (1864); 'Greece, Ancient and Modern' (1867); 'Selections from Modern Greek Writers'; etc.

Felton, Samuel Morse, American railroad president: b. Philadelphia, Pa., 3 Feb. 1853. He is a nephew of C. C. Felton (q.v.). He early entered railway service, being employed by the Chester Creek Railroad 1868 and appointed assistant engineer of the Lancaster Railroad 1870. He worked his way upward on various roads, through the positions of chief engineer, general superintendent and general manager, to the vice-presidency of the Erie Railroad 1885–90. He also served as president of several southern railroads and became president of the Chicago & Alton Railway Company 7 Sept. 1899.

Feltre, Henri Jacques Guillaume Clarke, Duc de, äṅ rē zhäk gē yōm klärk dük dė feltr, a marshal of France: b. Landrècies, France, 17 Oct. 1765; d. Neuviller, France, 28 Oct. 1818. In 1781 he entered the military school at Paris, and was afterward imprisoned during the Revolution. He was subsequently employed by Carnot; in 1807 he became minister of war and was created Duc de Feltre. Though indebted to Bonaparte for his dukedom, he contributed toward the restoration of the Bourbons, by whom, in 1816, he was created marshal of France.

Felucca, fē luk'ä, a class of small merchant-vessels used in the Mediterranean. They have two masts, carrying lateen sails, and frequently have a rudder at each end. Formerly feluccas were also employed in war and piracy.

Female Rhymes (Fr. *rimes féminines*), double rhymes, or rhymes in which two syllables, one accented and the other unaccented, correspond at the end of each line. They are so called because they end in a weak or feminine syllable; thus, fable, table; motion, notion, are female rhymes.

Femern, fā'mĕrn, or **Fehmarn,** fā'märn, an island in the Baltic; taken from Denmark in 1864 and now part of Sleswick-Holstein, Germany. Area, 70 square miles; surface, level; soil, fertile, producing corn. Cattle are abundant. The inhabitants are mostly engaged in fishing, and agriculture. Large quantities of stockings knit by hand are exported. Pop. 9,900.

Femgerichte. See Vehmgerichte.

Femur, fē'mur, the large bone of the thigh. The femur is the chief supporting bone of the lower limbs and is in man the main organ of locomotion, for the larger muscles of the thigh and hip are attached to it. It is the largest and longest bone of the body. The upper extremity includes a head, neck, and two bony protuberances which give attachment to the muscles rotating it. The head fits into the socket in the hip-bone, making a ball-and-socket joint. (See Hip-Joint.) It is this joint that so frequently becomes affected in tuberculosis, resulting in deformities, and also at this joint that the dislocation of the femur takes place. The main shaft of the femur is nearly circular above; below, it is somewhat flattened, and running throughout its entire posterior surface there is a rough ridge to which muscles are attached. The lower end of the femur is enlarged, and has two surfaces to articulate at the knee with the tibia and fibula of the leg. These are known as the internal and external condyles, the external one being the broader, the internal the narrower and more projecting behind and to the sides. The upper portion of the front surface of the lower end of the femur is grooved to receive the patella or kneecap. The femur averages about 18 inches in the male, and is about one inch shorter in the female. It is inclined inward at an agle of about nine degrees in the male. In the female, by reason of the comparatively broader pelvis, the angle of the femur inward is greater. Consult: Gerrish, 'Human Anatomy' (1902). See Leg; Skeleton.

Fen, a place overflowed with water, or abounding with bogs, as the bogs in Ireland, the fens in Lincolnshire, Kent, and Cambridgeshire. These fens abound in duck, teal, mallards, pike, eels, etc., and an herbage that is very nourishing to sheep and cattle. The soil of fen lands is generally black and rich to a depth of two or three feet.

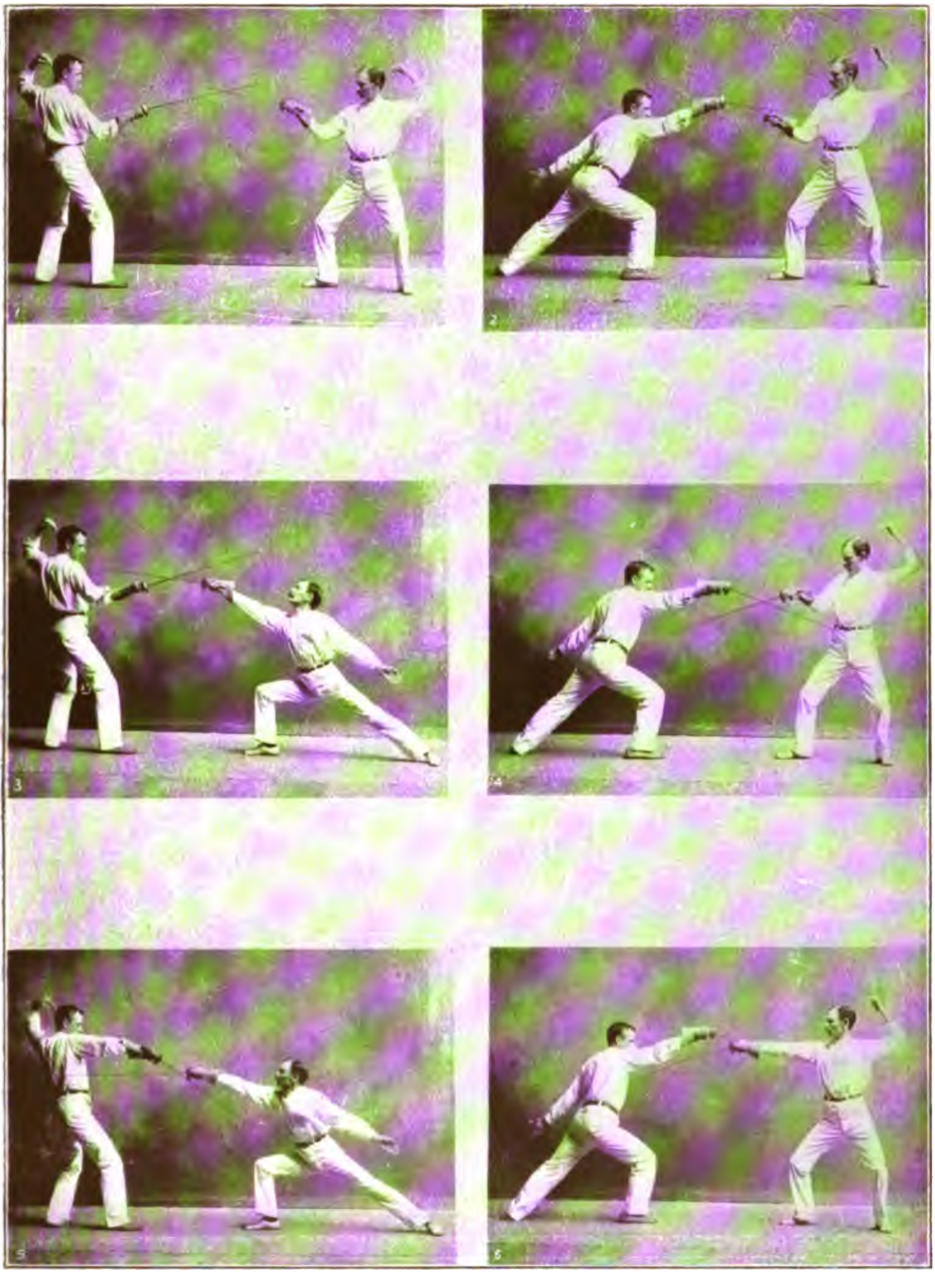
Fence Lizard. See Sceloporus; Swift.

Fence-viewers, town officers in New England to supervise the erection and repair of fences along the highways, or of boundary fences between private owners if called upon by either party. In early colonial days they had other duties also, including that of building inspectors.

Fences, continuous lines of obstacles artificially interposed between one portion of the surface of the land and another for the purpose of separation or exclusion. The kind of obstacle or material varies according to the articles to be excluded, confined, or separated, and the nature of the soil and situation. All fences are either live or dead, or a combination of these. Live fences are hedges, that is, rows of trees or shrubs, such as hawthorn, crab, blackthorn, holly, beech, box, etc., planted close together, and pruned on the sides. Dead fences are stone walls, structures of wood or iron, or mounds of earth, or ditches. Iron or wire fences are now in common use and vast tracts of waste land in this country are enclosed in this manner. Strong wires are stretched on posts firmly secured in the ground at from 100 to 200 yards distance from each other; a number of lighter posts are put in at 4 to 6 yards distance; when the wires are stretched they are fixed to the smaller posts by staples if the posts are of wood, or threaded through if of iron. The snake fence, also called rail fence and stake and rider fence, is made of split rails laid zigzag, with the ends resting on each other, supported by posts in pairs driven into the ground. A ring fence is one which completely encircles an estate. The height of fences is regulated by statute in the United States, the general height being four feet, although in some States it is four and a half feet. The practice of fencing has provided the language with striking figures of speech. «To be on the fence,» is a phrase used of a man who does not commit himself to any political party or take sides in any question. «To repair one's fences,» or «to look after one's fences,» is a phrase used in the United States for the efforts made by a politician to further his own interests, especially among his constituents.

Fencing, the art of attack and defense, with any weapon having either a point or an edge. In the general acceptance of the word, it means the use of the sword or foil, particu-

FENCING.



1. On Guard.
2. Attack and Parry of Quarte.
3. Attack and Parry of Tierce.
4. Attack and Parry of Septime.
5. Attack and Parry of Seconde.
6. A Riposte in Seconde, after a Parry of Tierce.

larly the latter. All swords may be divided into two general classes, small swords and broadswords; the former being one with which the attack is delivered with the point only, the latter one that has a cutting edge.

The foil used in fencing represents the small sword. The earliest swords of which there are any authentic records were those of the Assyrians and Greeks. They were straight or leaf-shaped, and made of bronze. The swords of the Romans were of steel, short, straight, and double-edged.

Light armor was worn by both the Greeks and the Romans, and a shield was carried for defense. During the Middle Ages when complete armor was worn, the sword was a long, heavy weapon used for striking blows, reliance being placed entirely upon the armor for defensive purposes.

When, after the invention of gunpowder, armor began to be discarded, it became evident that some other means of defense must be discovered, and it was in meeting this need that the art of fencing came into existence. The Italians were the first to recognize the fact that the point was more deadly than the edge, and that a thrust could be delivered more quickly than a blow, and to them belongs the credit of laying the foundations of the present school of fence. They invented the rapier, a long, straight sword having a cup-shaped guard with quillons, which was the parent of the small sword and foil. The early rapier was a weapon of offense only, parries being made with a dagger held in the left hand, or the point avoided by a leap aside. Camillo Agrippa of Milan was the first man to divide the body into four parts and to assign a definite guard to each. Agrippa published a book in 1553 explaining his system, which is said to have been illustrated by Michelangelo.

When daggers ceased to be worn, the cloak wrapped around the left arm was used in parrying. Later as the art of fence became better known, even the cloak was discarded, and the sword became a weapon of defense as well as offense.

While the Italians were building up their school on practical lines, the Spaniards invented a most complicated system of fence based on mathematical and geometrical principles. It was, however, of little use in actual fighting save that it taught coolness. The French and English were both followers of the Italian school, rapier play being introduced into England during the early part of Queen Elizabeth's reign. During the 18th century, the rapier, which had been constantly growing lighter, was replaced in France by the small sword, a weapon almost as light as our modern foil. The Italians, however, still clung to their ancient weapon and hence arose the two rival schools of fence, the French, and the Italian. Fencing masks also came into use at this time.

Broadsword play in some form or other was in existence during the periods of both the rapier and small sword and did not differ in its essential features from the system in use to-day. The Scots have always been especially noted for their dexterous use of the claymore, a species of heavy broadsword.

The French foil used in fencing consists of a quadrangular-shaped blade about 33 inches long, mounted in a slightly curved handle, and having either a bell-shaped or ring guard. The blade is divided into two imaginary parts, the part nearest the point being termed the «feeble,» that nearest the guard the «forte.» Parries are made by opposing the forte of one blade to the feeble of another. The foil is held in the right hand with the fingers underneath, the thumb extended along the upper part of the handle and nearly touching the guard. The thumb and forefinger direct the blade, the grasp of the other fingers being tightened or relaxed as occasion requires. In coming «on guard» the fencer raises his hand to the height of his breast, curves his arm so that his elbow will be about six inches from his body, and places the point of his foil on a level with his adversary's eye. At the same time he places his feet at right angles, about 12 inches apart, with the right foot in front, bends his knees, keeping the weight of the body slightly more on the left leg than on the right, and curves the left arm so that the hand will be behind the head. For fencing purposes, the body is divided into inside and outside, and high and low lines; an inside line being one to the left of the blade, an outside line one to the right of it; a high line one above the hand and a low line one below it. The high inside lines are termed Prime and Quarte, the low ones Septime and Quinte. The high outside lines are Tierce and Sixte, the low ones Octave and Seconde. All attacks, no matter how complicated, must eventually be delivered in one of these lines. For each attack there is a simple and a counter parry. Simple parries are made by turning aside the opposing blade in the line in which the attack is delivered; counter parries are made by circling round the blade and carrying it off in the line from which the attack began. To deliver an attack, the right hand is raised quickly to the height of the face, the right arm straightened, and the point directed against the place to be attacked. At the same time, the left leg is straightened, the right foot advanced, and the left hand dropped to a position about four inches above the left knee. This movement is termed the «Lunge.»

Whenever fencers are in the position of guard opposing each other, they are said to be «engaged.» Carrying the blade into another line is called «disengaging.» An opening for an attack is made by feinting in one line and attacking in another, by forcing the blade aside, or by a combination of these movements. After a parry, a fencer delivers a return thrust termed a «Riposte,» with which he endeavors to hit his opponent before he can recover his guard.

Hits only count when the point is placed squarely on the jacket between the neck and the hip. Disarming does not count and is not now practised to any great extent. The Italian foil is a trifle longer than the French one and has a straight handle, a bell guard and quillons. It is held by hooking the first and second fingers of the right hand around the quillons, the other fingers being tightly grasped around the handle, while the thumb is placed over the flat piece of the blade which is between the guard and its crosspiece. Further rigidity of the grasp is often assured by binding the foil tightly against the wrist with a long piece of tape. When on guard, the right arm is nearly straight, on a line with the shoulder, with the point directed at the opponent's chest. The body is always more effaced (turned away from the opponent) in the Italian school than in the French. The Italians divide the body into eight lines, as do the French, but as a general rule they use only four of them (quarte, tierce, septime and seconde) in making their attacks. Their parries are made more forcibly than those of the French; in some of them the movement of the forearm being very pronounced. The Italians fence much more vigorously than do the French and have a number of startling tricks, such as dropping under, or stepping away from the opposing blade, which they have retained from their old rapier play. The dueling sword is a heavier kind of foil, having a triangular blade and a large bell guard. It is used in nearly the same manner as a foil, but a hit may be made with it upon any part of the person.

In the use of the broadsword the attack is delivered with the edge rather than with the point. A limited number of thrusts can be made with it, but it is primarily a cutting weapon. The swords used for this kind of fencing are of various weights and shapes, the majority of them, however, are of the sabre model, with blunted edges and rounded points. Wooden singlesticks are also used. In assuming the position of guard the sword is held in the right hand with the thumb extended along the back of the grip, the edge to the right, with the hand at the height of the breast. The positions of the body and the feet are the same as in foil fencing, but the left hand is placed at the small of the back instead of behind the head. Attacks with the broadsword are made by giving a cutting blow with the edge. Cuts are made for the head, cheek, chest, girdle, flank, thigh, leg and arm. Thrusts with the point may also be made at the body. Cuts are parried with the edge; thrusts, with the back of the blade.

The student corps of Germany have a system of fence with a long straight sharp sword called a *schläger,* which differs from sabre play, in that the cuts are directed solely against the head. In this kind of fencing, masks are not worn, the eyes, ears, and throat, alone being protected, the sword arm is heavily padded and the blows are made with a wrist movement only.

The Japanese have a method of sword play which differs greatly from any of the present European systems. Their sword is a weapon some two and a half to three feet in length, having a heavily backed blade, a very sharp edge, a long handle, and a small protecting guard. It is wielded with both hands, the right hand being placed close to the guard and the left hand grasping the end of the grip. The first two fingers of both hands control and direct the blow, the grasp of the other fingers being tightened or loosened as occasion requires. The edge is generally kept downward while on guard. Cuts are made for the head, wrist, and waist, and thrusts for the throat and abdomen. A marked peculiarity of Japanese fencing is that parries are always made with the back or side of the blade, never with the edge. Bamboo swords are used for practice.

The bayonet attached to the end of a rifle makes a formidable weapon which is wielded in the same general manner as the small sword. In the position of guard, however, the left foot is in front, and the piece is grasped at the small of the stock, with the right hand, and at the balance with the left. When employed against cavalry the footman endeavors if possible to attack the horseman from the left side.

Among the famous fencers of the past four men stand out pre-eminently. These were the Chevalier de Saint Georges; the Chevalier d'Eon de Beaumont; Henry Angelo; and Jean Louis; all of whom lived during the latter part of the 18th or the early part of the 19th century, and were renowned for their great skill at fence. The prominent fencing masters of the present day are Mérignac, Prévost and Rouleau of the French school; and Conte and Pini of the Italian school. In the United States Gousky, Senac and Rondelle are well known masters. Contests for the amateur fencing championship of America are held annually under the auspices of the Amateur Fencers League of America.

Consult: Castle, 'Schools and Masters of Fence'; Alfred Hutton, 'Old Sword Play'; 'The Sword and the Centuries'; Louis Rondelle, 'Foil and Sabre'; and Bazancourt, 'Secrets of the Sword.'

Fred Gilbert Blakeslee,
Late Swordmaster 1st Regiment, Connecticut National Guard.

Fen'dall, Josias, colonial governor of Maryland: b. England about 1620. He was governor of Maryland 1656–60, and received a large landed estate from Lord Baltimore. He was superseded by Calvert, and was heavily fined and banished for sedition 1681.

Fénelon, François de Salignac de la Mothe, fräṅ-swä dė sä-li-nyäk dė lä mōt fān lôṅ, French missionary: b. 1641; d. 1676. He was a half-brother of Archbishop Fénelon (q.v.). He emigrated to Quebec in response to Bishop Laval's appeal for missionary reinforcements, and being a Sulpician established a mission of his order on the north shore of Lake Ontario. In 1674 he offended the choleric Frontenac, governor of New France, by a sermon, was summoned before the council and ultimately felt himself compelled to leave for Europe. He was forbidden by the king to return to Canada.

Fénelon, François de Salignac de la Mothe, French prelate: b. Château de Fénelon, Périgord, France, 6 Aug. 1651; d. Cambray 7 Jan. 1715. He was educated at Plessis College in Paris, and at the seminary of St. Sulpice, where he received holy orders in 1675. In 1678 he was appointed head of an institution, then newly organized in Paris, for the reception of women converts to the Roman Catholic faith; and the success with which he there discharged his duties led to his appointment as head of a mission to Saintonge for the conversion of the Huguenots. In 1689, Louis XIV. entrusted to him the education of his grandsons, the dukes of Burgundy, Anjou, and Berri; and in 1694 he was created archbishop of Cambray. A theological dispute with Bossuet, his former instructor, terminated in the condemnation of Fénelon's side of the controversy by Pope Innocent XII., and his banishment to his diocese by Louis XIV. To the Pope's decision Fénelon unreservedly and humbly submitted.

His works in philosophy, theology, and the belles-lettres have immortalized his name. He was familiar with the best models of ancient and modern times, and his mind was animated by a mild and gentle spirit of benevolence. His style is fluent and pleasing, pure and harmonious. His most celebrated work is 'Les Aventures de Télémaque,' in which he endeavored to exhibit a model for the education of a prince. It was carried off and published by a valet employed to transcribe the manuscript. On the appearance of this work Louis manifested displeasure toward Fénelon, conceiving this historical romance to be a satire on his reign, and forbade the completion of the printing. Some malicious persons pretended, what Fénelon himself never thought of, that Calypso represented Madame de Montespan, Eucharis Mademoiselle Fontanges, Antiope the Duchess of Burgundy, Protesilaus Louvois, Idomeneus the exiled King James, and Sesostris Louis XIV. Among his other works are: 'Traité de l'Education des Filles'; 'Traité du Ministère des Pasteurs'; 'Explication des Maximes des Saintes'; 'Dialogues on the Eloquence of the Pulpit'; 'Demonstration of the Existence of God'; 'On the Temporal Power of the Mediæval Popes.' See Ramsay, 'Vie de Fénelon' (1725); Bossuet, 'Histoire de Fénelon' (1808); Gosselin, 'Histoire Littéraire de Fénelon' (1843); Butler, 'Life of Fénelon' (1810); Lamartine (1854); Roy, 'Histoire de Fénelon' (1842); Werfer, 'Leben des Fénelon' (1852); Gandar, 'Fénelon et son Temps' (1864); Lear, 'Fénelon, Archbishop of Cambrai' (1876); Crausle, 'Fénelon et Bossuet' (1895); Sanders, 'Fénelon: His Friends and His Enemies' (1901); Saint Cyres, 'François de Fénelon' (1901).

Fenelon Falls, Canada, township in Victoria County, province of Ontario. A waterfall 300 feet wide, 21 feet high, is the chief attraction of the place. The river affords facilities for the transportation of lumber, in which the vicinity abounds. Pop. 1,150.

Fenestra'tion, in architecture, is, in contradistinction to columniation, the system of construction, mode of design, and arrangement of windows in a building.

Fenians, a name said to be derived from Fionn or Finn, an Irish hero of the 2d century, assumed in recent years by those Irish who formed a brotherhood in their own country and in America, with the intention of delivering Ireland from the sovereignty of England, and establishing an Irish republic. About the end of 1861 the Fenian Brotherhood was regularly organized in America; and its chief council, consisting of a "head-centre" and five other members, which had its seat at New York, soon had branches in every State of the Union; while at the same time large numbers joined the cause in Ireland. The close of the American Civil War, when large numbers of trained Irish soldiers who had taken part in the war were released from service, was thought to be a convenient time for taking some decisive steps. Two risings were planned in Ireland, but they were both frustrated by the English government, which had received timely information. The first, in September 1865, was prevented by the seizure of the office of the 'Irish People,' the Fenian journal published at Dublin, in which papers were found which revealed to the government the secrets of the conspiracy, and which led to the capture of a number of suspects. The second, in February 1866, was suppressed by the suspension of the Habeas Corpus Act in Ireland.

An invasion of Canada was attempted in the same year. The advocates of Ireland's independence counted upon aid from the veterans of the Civil War, who were incensed at England's attitude toward the United States during the war. In this they were not disappointed; as among the trained men who were under command of Gen. Sweeney, himself an ex-officer of the United States army, there were many men not of Irish blood or lineage. The troops under Gen. Sweeney are estimated to have been at least 35,000 in number; but so well was the recruiting done that reserve forces who never went to the frontier numbered about 200,000. Gen Sweeney's men, in May 1866, were stationed at various points on the frontier from Lake Erie to Lake Champlain; at St. Albans, Vt., under Gen. Spear; at Rouse's Point, N. Y., under Gen. Reilly; at Malone, N. Y., under Col. Michael C. Murphy (q.v.), and around Buffalo, under Gen. John O'Neill (q.v.). Large quantities of arms and ammunition were sent north, a sufficient amount for 50,000 men; but the United States officials hearing of the expected raid, seized the consignment of arms addressed to suspected Fenians, and when the troops arrived on the frontier they were powerless because of lack of arms. An attempt was made to regain them, but the officers were arrested by the United States government. Gen. O'Neill invaded Canada by way of Fort Erie and two battles followed, in both of which O'Neill was successful. One, known as the "Battle of Ridgeway," occurred 1 June 1866. Reinforcements not arriving as expected, O'Neill abandoned the place and returned to the American side. He, his staff, and men were captured by the United States gunboat Michigan. The whole movement was crushed at that time by the United States forces under Gen. Meade, who acted under government instructions in accordance with the treaty between the United States and England. On 18 Sept. 1867 occurred, in England, the release by force of prisoners from a prison van which was conveying Kelly, the Fenian chief, and Deasy, his assistant, to Manchester prison. (See MANCHESTER MARTYRS.) In 1870 and 1871 another and unsuccessful attempt was made to gain a foothold in Canada. Various crimes and attempted crimes against the English government and anti-Home Rule leaders have been charged against the Fenians; but they were repudiated and denounced by the Fenians themselves, and attempts to prove them guilty have failed. Various organizations have taken up the cause for which the Fenians labored, and other methods have been used to secure some form of self-government for Ireland. (See HOME RULE.) Consult: Sullivan, 'Story of Ireland.'

Fenn, George Manville, English novelist: b. Westminster 3 Jan. 1831. His earliest literary ventures were short sketches published in 'All the Year Round, Chambers' Journal,' and 'Once a Week' (of which he became proprietor in 1873). In 1867 he published 'Hollowdell Grange,' a story for boys, which has since been followed by a long series of excellent and highly popular tales and novels, many of them boys' stories. The following may be specially mentioned: 'Bent, not Broken' (1867); 'The Parson o' Dumford' (1879); 'Eli's Children'

(1882); ‹The New Mistress› (1883); ‹Double Cunning› (1886); ‹The Master of the Ceremonies› (1886); ‹The Man with a Shadow› (1888); ‹A Double Knot› (1890); ‹The Mynns Mystery› (1891); ‹King of the Castle› (1892); ‹In an Alpine Valley› (1893); ‹High Play› (1898). Among his boys' books are: ‹In the King's Name›; ‹Nat the Naturalist›; ‹Bunyip Land›; ‹Menhardoc›; ‹Patience Wins›; ‹Brownsmith's Boy›; ‹Commodore Junk›; ‹The Crystal Hunters›; ‹The Grand Chaco›; ‹Blue-jackets›; ‹Fire Island.› Mr. Fenn has also produced, either alone or in collaboration, several works for the stage.

Fenn, Harry, American artist: b. Richmond, Surrey, England, 14 Sept. 1838. He removed to the United States in 1856 and has achieved great success as an illustrator of books. He was one of the founders of the American Water Color Society. Some of his best work is contained in ‹Picturesque America›; ‹Picturesque Europe›; and Picturesque Palestine.›

Fenn, William Wallace, American Unitarian clergyman: b. Boston 12 Feb. 1862. He was graduated at Harvard 1884 and at the Harvard Divinity School 1887, and was ordained to the ministry in 1887. He has since had charge of churches in Pittsfield, Mass., (1887–91), and Chicago (1891–1901). He was lecturer on biblical literature in Meadville Theological School 1892–1901 and in the last named year was appointed professor of systematic theology in Harvard Divinity School. He has published: ‹Lessons on Luke› (1890); ‹Lessons on Acts› (1894); ‹The Flowering of the Hebrew Religion› (1894); ‹Lessons on Psalms› (1900).

Fen'nec, a small desert animal (*Fennecus zerda*) found in the Sahara, which looks like a diminutive fox. It is of a pale creamy yellow color, harmonizing well with its sandy habitat; its breast is white, and the tail tipped with black. It is a graceful little animal, about 15 inches long, with a bushy tail, about 7 inches in length; and its small face and large erect ears give it an expression of attentive hearkening for unseen foes. It burrows into the sand, and can dig so rapidly as to escape pursuers. It is, like most of its kind, nocturnal in habits, searching for water and its food — small birds, mice and insects — after the sun sets, spending the day curled up in its burrow.

Fennel, a plant of the genus *Fœniculum* of the carrot family. The plant is native of parts of England, and is common from New Jersey, through Pennsylvania to Virginia and Louisiana, as a fugitive from cultivation. The plant has umbels of small yellow flowers, and finely divided leaves. It grows to the height of three or four feet. In its natural state the seeds are intensely acrid. By cultivation this acridity is lost, and an agreeable taste and flavor acquired. In European cookery the leaves are often used as a seasoning, or as an accompaniment of fish. A smaller species, sweet or Italian fennel (*F. dulce*), is commonly cultivated on the continent of Europe, and is used in salads, soups, etc. Several other species of fennel are known, some of which are admired for their pungency. The seeds (or «half fruits») are flat on one side and convex on the other, seldom exceeding one fourth of an inch in length. They have a fragrant odor, and warm, pleasant taste. Their infusion in boiling water is used as a carminative, and having no actively exciting qualities, is employed to disguise by its pleasant aromatic nature the flavor of disagreeable medicines, as senna and rhubarb. The oil of fennel is obtained from the seed. It is yellowish, somewhat thick, with an aromatic odor and sweet taste. It is lighter than water, and solidifies with moderate diminution of temperature.

The seed from which the volatile oil is obtained is used in medicine as an aromatic stimulant and as a carminative. It is useful in infantile diarrhœa with excessive fermentation, and as a flavoring vehicle for many medicines.

Fenollo'sa, Ernest Francisco, American writer: b. Salem, Mass., 18 Feb. 1853; d. London, Eng., 21 Sept. 1908. He was professor of political economy at Tokio University, Japan, 1878–80, and of philosophy and logic 1880–6; professor of æsthetics in the Tokyo Fine Arts Academy 1887–90; and curator of the oriental art department, Boston Art Museum 1890–6, and in 1897 he became professor of English in the High School of Tokyo. He published monographs on art and ‹The Discovery of America and Other Poems› (1893).

Fenollosa, Mary McNeil, American writer: b. Alabama. She was married to E. F. Fenolosa (q.v.), 28 Dec. 1865, and has since published ‹Out of the Nest: a Flight of Verses› (1899); ‹Children's Verses on Japanese Subjects›; ‹Hi roshige.›

Fenton, Elijah, English poet: b. Shelton, Staffordshire, 20 May 1683; d. East Hampstead, Berkshire, 13 July 1730. He studied at Cambridge, but becoming a non-juror he was obliged to leave the university, after which he accompanied the Earl of Orrery to Flanders as private secretary. Some years later Fenton became associated with Pope, who was then undertaking his version of the ‹Odyssey,› and was in quest of assistants. According to Dr. Johnson, Fenton translated the 1st, 4th, 19th, and 20th books of that poem. In 1723 a tragedy entitled, ‹Mariamne,› which he brought out, had an immense success, and gained him more than £1,000. In 1727 he published a new edition of Milton's works, to which he prefixed a brief but elegant life of the author. This was soon followed by a fine annotated edition of Waller.

Fenton, Ferrar, English author: b. Lincolnshire 1832. Among other works he has published: ‹Seven Years of an Indian Officer's Life›; ‹Poems from the Persian›; ‹The New Testament in Modern English›; ‹The Five Books of Moses, direct from the Hebrew, in Modern English with Critical Notes›; ‹St. Paul's Epistles in Modern English.›

Fenton, Reuben Eaton, American statesman: b. Carroll, Chautauqua County, N. Y., 4 July 1819; d. Jamestown, N. Y., 25 Aug. 1885. He was admitted to the bar in 1841; was elected to Congress in 1852, and there opposed the further extension of slavery. In 1856 he was again elected to Congress, where he remained till 1865, when he resigned to become governor of New York, in which office he served for two terms. In 1869–75 he sat in the United States Senate, and in 1878 was chairman of the United States Commission to the International Monetary Conference in Paris.

Fenton, England, town of Staffordshire, near and to the southeast of Stoke-upon-Trent. The chief industries are china and earthen-ware manufacture, brick making, coal mining and iron founding.

Fen'ugreek, the seed of *Trigonella fœnum-græcum,* a plant of eastern Europe and western Asia and which spreads throughout the Mediterranean basin. It is a member of the clover family, and has been used like clover for many years as a fodder plant. The seed contains an aromatic essential oil, and has been very extensively used as a seasoning. In medicine its use has practically been abandoned, although the seed has unquestionably many excellent properties, its food value alone being considerable. It is still very extensively used in veterinary practice.

Fen'wick, Ethel Gordon, English nurse: b. 26 Jan. 1857. She married Dr. Bedford Fenwick in 1887. She has been connected with various English hospitals as nurse, and is a member of many nurses' associations. She was president of the British Nursing department at the Chicago World's Fair, receiving two medals on that occasion; was awarded the Red Cross medal in the Græco-Turkish war 1899, and was president of the International Nurses' Congress at Buffalo 1901. She is the editor of ‹The British Journal of Nursing.›

Fenwick, George, American colonist: b. England about 1602; d. 15 March 1657. He came to America in 1636 to take charge of the plantation of Saybrook, so called after Lords Say and Brook, who, with others, in 1632 had procured a patent for the territory from Robert, Earl of Warwick. Returning to England, he came back again in 1639, and from that time, as one of the patentees, and agent for the others, superintended and governed the settlement of Saybrook till 1644, when he sold its jurisdiction and territory to the Connecticut colony, as his associates had given up their contemplated removal to America. He afterward returned to England, where he was appointed one of the judges for the trial of Charles I., but did not act in that capacity. He served in Cromwell's army in Scotland in 1650.

Fenwick, or **Fenwicke, John,** American colonist: b. England 1618; d. 1683. He was a Quaker and settled at Salem, N. J., in 1675 with a colony of Quakers. Disputes arose with Gov. Andros of New York, and Fenwick was arrested and remained two years in prison, being released on parole. His land grants passed to the possession of others during his life, and he died in poverty.

Fenwick, Sir **John,** English conspirator: b. England about 1650; d. 28 Jan. 1697. He became major-general in the army, and was a member of parliament in 1677. He conspired with others against William III. and was accused of participation in the Assassination Plot in 1696. A bill of attainder being passed, he was executed for high treason, the last execution in Great Britain in consequence of attainder.

Feodor I., Ivanovitch, ē-vän'ō-vich fä'ō-dōr, Russian czar: b. 11 May 1557; d. 7 Jan. 1598. He began his reign in 1584, and being weak both in body and mind, assigned the government of his affairs to Godunoff, who seems to have managed them with dexterity and vigor. In his reign the peasants of Muscovy were converted into serfs and attached to the land. Previously they had enjoyed personal liberty. The conquest of Siberia was achieved by Godunoff, and many remarkable diplomatic relations with foreign courts were effected.

Feodor II., Alex'ievitch, Russian czar: b. 1589; d. 10 June 1605. He was the son of Boris Godunoff.

Feodor III., czar of Russia, and eldest brother of Peter the Great: b. 8 June 1656; d. Moscow 27 April 1682. He ascended the throne when only 19 and evinced a strength of will and determination of character which, had he lived, might have anticipated the reforms which his younger brother subsequently effected. His reign is rendered memorable on account of his calling into his presence the Muscovite nobles, who desolated the country with broils about their claims of family precedence, and throwing the rolls of the Razriad or «Arrangement,» into the fire. The genealogical records, which did not relate to claims of precedence, were preserved and properly arranged in accordance with his will.

Feodosia, fä-ō-dō'sē-ä (ancient Caffa or Kaffa), Russia, town on the west angle of a magnificent bay in the southeast of the Crimea. The ancient Theodosia, from which the modern Feodosia takes its name, was founded at a very early period by a colony of Greeks from Ionia, and its site was probably not far from its modern namesake. From 1266 to 1474 or 1475 this town was in the possession of the Genoese, except for a short interval about the end of the 13th century, when it was held by the Venetians. While in the hands of the Genoese it was the seat of an extensive commerce with the East by way of Astrakhan and the Caspian Sea, and at that time it is said to have had a population of 80,000. From the Genoese it was taken by the Turks, and after that its prosperity rapidly declined. Much has been done for it since it came into the possession of Russia, and it is still one of the most important towns in the Crimea.

Fer-de-lance, fär-dė-läṅs, the lance-headed or yellow viper (*Lachesis lanceolatus*), a serpent native to northeastern South America, and one of the most terrible members of the rattlesnake family. It is ordinarily 3 to 4 feet in length when full-grown, and has no rattle, but the tail ends in a horny spine which is vibrated rapidly when the snake is excited. It has the general appearance and habits of the rattlesnake (q.v.), feeds upon small mammals, frogs and the like, and was long ago introduced into Martinique, Santa Lucia and a few other of the Antilles, as a means of devouring the rats which were a pest to the fields of sugarcane. It flourished and multiplied greatly, and has become greatly dreaded by all who work in the fields of those islands.

Feræ, fē'rē, wild animals; a term adopted by Linnæus for one of his orders of *Mammalia*; embracing a variety of carnivorous animals now scientifically reclassified.

Feræ Naturæ, fē'rē na-tū'rē («of a wild nature»), the legal name for beasts and birds that are wild or non-domesticated, as contradistinguished from those which are *domitæ naturæ,* that is, tame animals, such as horses, sheep, etc. The Roman law held such animals as naturally belonging to the first person who should take possession of them, but regarded the right of possession as continuing only as long as the possessor kept them in confinement. As soon as the animal escaped it again became common property, and might be taken possession of by any other person who could capture it, unless the animal had an *animum revertendi,* that is, an intention of returning, which it was to be presumed it had, if it had been trained to return to its master's property, and was in the habit of doing so. This principle has been adopted by both British and American law. When such animals as are classed as *feræ naturæ* make nests or burrows on any person's property, and have young, the young are held as belonging to this person as long as they are unable to fly or run away. Those persons who have the right of hunting, taking, or killing those wild animals which are included under the designation of game, have a qualified property in such animals as long as they continue within their liberty, but no longer. A person who keeps an animal indisputably *feræ naturæ* is responsible for any injury which it may do to the person or property of another. Consult: Schouler's 'Treatise on the Law of Personal Property' (1896).

Fer'dinand I. (surnamed "THE JUST"), king of Aragon: b. 1379; d. Igualada 2 April 1416. He was king of Aragon 1412–16, and was succeeded by Alfonso V.

Ferdinand II., king of Aragon. See FERDINAND V. OF CASTILE.

Ferdinand I., emperor of Austria: b. Vienna 19 April 1793; d. Prague 29 June 1875. He was a son of Francis I. and ascending the throne in 1835, continued to pursue the policy of his father, leaving the chief direction of affairs in the hands of Metternich (q.v.). In his reign, the republic of Cracow was annihilated, and a portion of it added to the empire. During the revolutionary war of 1848 he dismissed Metternich and made several concessions which were found insufficient. Vienna revolted in May, and Ferdinand at length retired to Olmütz, and on 2 Dec. 1848, abdicated, having no children, in favor of his nephew, Francis Joseph I.

Ferdinand I., German emperor: b. Alcalá, Spain, 10 March 1503; d. Vienna 25 July 1564. He was a brother of Charles V., after whose abdication in 1556 he took the title of emperor of Germany, although his claim to the title was not recognized by the electors till 1558. In 1526 or 1527 he became king both of Hungary and Bohemia, and after that period these two kingdoms remained attached to the empire. Ferdinand had been chosen king of the Romans in 1531. In 1559 he held a diet at Augsburg, in which the currency of the empire was regulated, and many religious grievances suffered by the Protestants were exposed. Ferdinand was of a mild and tolerant character, and in 1562 obtained from the Council of Trent several religious privileges for his subjects.

Ferdinand II., German emperor. b. Gratz, Styria, 9 July 1578; d. Vienna 15 Feb. 1637. He succeeded his uncle Matthias as emperor of Germany in 1619. His zeal was excited against every deviation from the decrees of the Council of Trent, and he firmly adhered to an anti-Protestant policy. The Bohemians, jealous of the privileges which they had secured from Rudolph, and of which they saw that Ferdinand was disposed to deprive them, declared that he had forfeited the Bohemian crown, which they offered to the Elector Palatine Frederick V., a step which lead to the outbreak of the Thirty Years' war. The support of the league, and of the Elector of Saxony, John George I., placed him firmly on the throne of Bohemia, where he vigorously pursued the Protestants, whose opposition to him was as much political as religious.

Ferdinand III., German emperor, son of Ferdinand II.; b. in Gratz, Styria, 11 (or 13) July 1608; d. Vienna 2 April 1657. He was made king of Hungary in 1625, of Bohemia in 1627, and succeeded his father in 1637.

Ferdinand I., king of Naples, illegitimate son of Alfonso I.; b. about 1424; d. 25 Jan. 1494. He succeeded his father in 1458. His false and cruel character provoked a civil war, in which John of Anjou took part with the barons, and the king was aided by the Pope Pius II., Sforza, Duke of Milan, and by Scanderberg. The king defeated his rival in 1462, and made peace; but breaking his word war broke out again. Again the king won, and established order by terror.

Ferdinand II., king of Naples, son of Alfonso II.; b. 26 July 1469; d. 7 Oct. 1496. He succeeded his father when the latter abdicated in 1495.

Ferdinand III., king of Naples. See Ferdinand V. of Castile.

Ferdinand IV., of Naples, and I., of the Two Sicilies: b. Naples, Italy, 12 Jan. 1751; d. there 4 Jan. 1825. He ascended the throne in 1759, and after the death of Louis XVI. he joined the coalition engaged in the general war against France (1793-6). The victory gained at Aboukir by Nelson again brought Ferdinand into a hostile attitude against the French, who summarily drove him from his kingdom in 1799. In the same year, however, his troops regained possession of the capital. In 1806 Ferdinand was again forced to abandon Naples, the crown of which Napoleon I. conferred first on his brother Joseph Bonaparte, and afterward on his brother-in-law, Murat (q.v.), Ferdinand, however, continuing to reign in Sicily under English protection. In 1814 the Congress of Vienna finally established Ferdinand as King of the Two Sicilies. Revolutionary movements, set afloat by the Carbonari (q.v.), compelled the establishment of a constitution, against the advice and interests of Austria, Russia, and Prussia; the first named power marched an army across the Po, defeated the Neapolitan army, and occupied Naples. Ferdinand who, refusing to sanction the liberal declarations of his subjects, had quitted his capital, was then reestablished, and ruled thenceforward with absolute power.

Ferdinand II., king of the Two Sicilies: b. Palermo 10 Jan. 1810; d. Naples 22 May 1859. He succeeded his father Francis I. 8 Nov. 1830. The new sovereign at first made some concessions to his subjects; but presently gave them to understand that henceforth his will was to be their only law, and that the least opposition to it would be followed by banishment or incarceration in a dungeon. This was no empty threat. Devoting much time to hunting, he left the government to be administered by favorites, and reserved his interference chiefly for occasions requiring the exercise of that mixture of obstinacy and energy which formed the leading feature in his character. After a succession of partial outbreaks, the revolutionary year of 1848 brought matters to a crisis, during which Ferdinand II. earned the nickname of "King Bomba," by bombarding his capital from the forts commanding it. At the commencement of the insurrection, which first broke out at Palermo, and threatened to extend over both divisions of the kingdom, Ferdinand issued a decree promising a constitution, but ultimately, when he had by main force re-established his ascendency, retracted all his promises and established one of the vilest despotisms which has disgraced modern times. Great Britain and France endeavored, by friendly remonstrance, to check him, and being only rebuked for presuming to interfere, testified their displeasure by withdrawing their ministers from Naples. This measure seems only to have made Bomba more resolute than ever to rule in his own way. He died leaving his dungeons crowded with the best and bravest of his subjects.

Ferdinand, titular king of Portugal: b. Vienna 29 Oct. 1816; d. Lisbon 15 Dec. 1885. He was a son of the Duke of Saxe-Coburg-Gotha, and married Maria de Gloria, Queen of Portugal, in 1836. The title of king was granted him in 1837, and after the queen's death, in 1853, he was regent till 1855, during the minority of his son Pedro. In 1869 he married an American singer, Eliza Hensla, whom he made Countess of Edla. He possessed not a little skill as artist and engraver.

Ferdinand I. (surnamed "THE GREAT"), king of Castile and Leon: b. about 1000; d. Leon, Spain, 27 Dec. 1065. He was the second son of Sancho II., king of Navarre, and by the death of Bermudo, 1037, he became king of Leon. He then made war against the Moors, from whom he took several cities, and pushed his conquests as far as Portugal. He next declared war against his brother, Garcias III., king of Navarre, in which that prince lost his kingdom and his life.

Ferdinand II., king of Leon: d. 1188. He was the son of Alphonso VIII., and in a war with Portugal made the king, Alphonso Henriquez, prisoner. In the reign of this prince the military order of St. James was instituted, 1177, for the purpose of defending the dominions of the Christian powers against the Saracens.

Ferdinand III. (surnamed "THE SAINT"), king of Castile and Leon: b. about 1200; d. Seville, Spain, 30 May 1252. He was the son of Alphonso IX., and obtained the crown of Castile by the abdication of his mother, Berengaria, in 1217, and that of Leon by the death of his father in 1230. He took many places from the Moors, was canonized by Pope Clement X., and is regarded as the founder of the University of Salamanca.

Ferdinand IV., king of Castile and Leon: b. Seville 1285; d. 1312. He succeeded to the throne of Castile in 1295, at the death of his father, Sancho IV.

Ferdinand V. (surnamed "THE CATHOLIC"), king of Aragon: b. Sos, Aragon, 10 March 1453; d. Madrigalejo, Spain, 23 Jan. 1516. On 18 Oct. 1469 he married Isabella of Castile (q.v.) and thus brought about a close connection between Aragon and Castile, although both kingdoms continued to be governed separately, for Isabella allowed her husband no other share in the government of Castile than the privilege of affixing his signature to the decrees, and of uniting his arms with her own. With Ximenes they raised Spain to an eminence which she had never before attained. After a fierce war of 10 years they conquered Granada (1491), the only kingdom of which the Moors yet retained possession in Spain; but the most brilliant event of their reign was the discovery of America, for which Isabella had furnished the ships, and which made them sovereigns of a new world. (See COLUMBUS.) This politic prince laid the foundation of the Spanish ascendency in Europe by the acquisition of Naples (1503), by means of his general Gonsalvo of Cordova, and by the conquest of Navarre (1512); but his policy was sometimes deceitful and despotic. These stains obscure the great qualities which made him the first monarch of his time. It was during his reign that the court of the Spanish Inquisition was established (1480). In 1492 he expelled the Jews from the kingdom, and banished the Moors in 1501. Two years after the death of his wife Isabella, which took place in 1504, he married Germaine de Foix. See Prescott, 'The Reign of Ferdinand and Isabella' (1837).

Ferdinand VI., king of Spain: b. 23 Sept. 1712; d. Villaviciosa, 10 Aug. 1759. He was the son of Philip V., and ascended the throne in 1746. He promoted the internal welfare of his country, reorganized the navy, encouraged manufactures, and by his judicious political conduct placed his elder brother on the throne of Naples, and another under the ducal canopy of Parma.

Ferdinand VII., king of Spain: b. San Ildefonso 13 Oct. 1784; d. Madrid 29 Sept. 1833. He was the eldest son of Charles IV. From the earliest years he manifested a strong dislike to the favorite Godoy, who ruled both the king and queen; and in 1807 was arrested as a conspirator. After the popular rising at Aranjuez, in March 1808, his father was forced to abdicate in his favor. A month later, having been induced to meet Napoleon at Bayonne, he himself abdicated in turn, placing the crown at the disposal of Napoleon, who at once gave it to his brother Joseph. Ferdinand was kept a prisoner at Valençay till 1813, when Napoleon offered to re-establish him on his throne. He returned to Spain in March 1814, having previously promised to maintain the constitution of 1812. In spite of his promise he annulled this constitution and dissolved the Cortes two months after his return. In consequence of this and of his arbitrary rule a military insurrection broke out 1 Jan. 1820. The rebels were at first successful, and Ferdinand was obliged to swear to the constitution of 1812; but having received support from Louis XVIII. of France, who sent an army to his aid, commanded by his nephew, the Duke of Angoulême, he was ultimately enabled to suppress the insurrection, and to make his authority once more absolute in Spain. Ferdinand was married four times, but only left one daughter, Isabella, by his fourth wife, Maria Christina of Naples. By a decree issued 29 March 1830, called the Pragmatic Sanction, he abolished the act of 1713, by which Philip V. had excluded women from the throne of Spain. He then left his crown to his daughter Isabella, to the exclusion of his brother, Don Carlos. It was during the reign of this king that the Spanish colonies in South America broke away from the mother country.

Ferdinand III., Joseph John Baptist, grand duke of Tuscany and archduke of Austria: b. 6 May 1769; d. Florence, Italy, 18 June 1824. He succeeded his father, the Emperor Leopold II., as grand duke of Tuscany, in 1790. He was the first sovereign to acknowledge the French Republic, and although compelled to join the first coalition against it, took the first opportunity of withdrawing. In spite of this he was, in 1799, at the time of the second coalition, deprived of his dominions, which, at the Peace of Lunèville, in 1801, were given to the Prince of Parma. He afterward received as compensation the duchy of Salzburg, in Germany, with the title of elector. In 1805 he exchanged Salzburg for the grand-duchy of Würzburg; in 1806 he joined the Confederation of the Rhine, and till 1813 remained a faithful ally of Napoleon. By the first Peace of Paris (30 May 1814) he recovered his hereditary dominions. See Inghirami, 'Storia della Toscana' (1843); Thayer, 'Dawn of Italian Independence' (1893); Tivaroni, 'Italia Durante il Dominio Austriaco' (1892-4).

Ferdinand IV., grand duke of Tuscany: b. 10 June 1835; d. 17 Jan. 1908. He was a son of Leopold II., whom he succeeded in 1859, and in 1860 his country was incorporated with the kingdom of Sardinia and subsequently with the kingdom of Italy.

Ferdinand, duke of Brunswick, German field marshal: b. Wolfenbüttel 12 Jan. 1721; d. Brunswick 3 July 1792. Entering the Prussian service in 1740 he rose rapidly and became one of the famous commanders of the age. He was also noted for his patronage of science and art as well as for his many benevolences.

Ferdinand, Maximilian, prince of Bulgaria: b. Vienna 26 Feb. 1861. He is the youngest son of Prince Augustus of Saxe-Coburg, and was offered and accepted the rulership of Bulgaria in 1887. In 1896 Turkey recognized his election as ruler and urged the other interested powers to do so, and in April following, the acts of reconciliation and recognition were completed by his being received by the czar and the diplomatic corps at St. Petersburg.

Ferdinand, Victor Albert Meinrad, prince of Rumania: b. Sigmaringen, Prussia, 24 Aug. 1865. He is the second son of Prince Leopold of Hohenzollern and nephew of Charles I. of Rumania, and was declared heir presumptive to the Rumanian crown in November 1888. In the following March he was granted the title of Prince of Rumania and declared successor to the crown. He married Maria, eldest daughter of the Duke of Edinburgh, in January 1893.

Ferdinand, a noted figure in Shakespeare's 'Tempest.' He is the son of the King of Naples, and after being shipwrecked through the magic of Prospero, on the latter's enchanted island, falls in love with Prospero's daughter, Miranda.

Ferentino, fā-ren-tē'nō (ancient FERENTINUM), Italy, city in the province of Latium, six miles northwest of the town of Frosinone. It belonged to the Volsci, under whom it rose to be a place of considerable importance, and it still exhibits the remains of ancient walls, built of hewn stone without mortar. It is the see of a bishop. Pop. 9,096.

Feretory, fĕr'e-tō-ri, the bier or shrine containing the relics of saints borne in processions, which was usually done upon their feast days, as a token of gratitude in times of public rejoicing, or to obtain some favor in seasons of calamity. The type of a feretory is a coffin, but the form is usually that of a ridged chest, with a roof-like top. It was made of precious metals, wood, or ivory.

Ferghanah, or **Ferganah,** fĕr-gä'nä, a province, since 1876, of Russian West Turkestan, formerly the khanate of Kokand, lying among the western ranges of the Tian-Shan Mountains; area, 35,654 square miles, four fifths of which are mountainous, the Tchotkal Mountains being in the north, and the Ala-tau and the Trans-Alatau chain in the south. The rest of the province consists of the fertile irrigated plain of the Sir-Daria (Jaxartes), which traverses Ferghanah from northeast to southwest. The chief towns are Kokand, capital; Margelan, Namangan, and Andidjan. Pop., estimated, 1,560,411.

Fergus (fur'gus) Falls, Minn., city, county-seat of Otter Tail County; on the Red River, the Northern P. and the Great N. R.R.'s. It is in the heart of the "park" section of the State, being surrounded by prairie land and forests of pine and hardwood and the Park Region. It contains the Norwegian Lutheran College, high school, public library, State Hospital for the Insane, waterworks, electric lights, several banks and newspapers. The manufactures are flour, lumber, wagons, sleighs, woolen goods, furniture, brooms, etc. Pop. (1910) 6,887.

Ferguson, Adam, Scottish writer: b. Logierait, Scotland, 20 June 1723; d. St. Andrews 22 Feb. 1816. He was graduated at the University of St. Andrews in 1742; was professor of natural philosophy in Edinburgh University in 1759, and of mental and moral philosophy 1764-85; and was later professor of mathematics. He wrote: 'Institutes of Moral Philosophy' (1769); 'History of the Progress and Termination of the Roman Republic' (1782); 'Principles of Moral and Political Science' (1792), etc.

Ferguson, Henry, American educator: b. Stamford, Conn. He was graduated at Trinity College 1868, and entered Episcopal ministry 1873. He was rector of Christ Church, Exeter, N. H., 1872-8, and rector of Trinity Church, Claremont, N. H., 1878-80. Since 1883 he has been professor of history and political economy at Trinity College. He has published: 'Four Periods in the Life of the Church,' 'Essays on American History.'

Ferguson, James, Scottish physicist: b. Keith, Banffshire, 25 April 1710; d. London 16 Nov. 1776. As soon as his age would permit he was employed by a farmer to tend his sheep, in which situation he acquired a knowledge of the stars and constructed a celestial globe. This extraordinary ingenuity becoming known he was enabled to obtain instruction in mathematics and drawing, in which latter art his improvement was so rapid that he drew portraits in miniature, by which employment he supported himself for some years. In 1743 he went to London, where he published astronomical tables and lectures and lectured on experimental philosophy. In 1763 he was chosen a Fellow of the Royal Society, without the usual fees. His chief works are: 'Astronomy Explained on Sir Isaac Newton's Principles' (1756 — many editions); 'Lectures on Select Subjects in Mechanics, Hydrostatics, Pneumatics, and Optics' (1760); 'Analysis of a Course of Lectures on Mechanics, Pneumatics, etc.' (1763); 'Young Gentleman's and Lady's Astronomy' (1768); 'Introduction to Electricity' (1770); 'Select Mechanical Exercises' (1773); 'The Art of Drawing in Perspective' (1775). Most of his works were very popular.

Ferguson, James, American astronomer and civil engineer: b. Perthshire, Scotland, 31 Aug. 1797; d. 26 Sept. 1867. In his infancy he was brought to New York (1800), and on reaching manhood worked as an assistant engineer in the excavation of the Erie canal (1817-19). The three following years he was employed as assistant surveyor to the boundary commission appointed to carry out the provisions of the Treaty of Ghent. From 1822 to 1827 he was astronomical surveyor on the same work. The pursuit of practical astronomy occupied his later life, and as assistant astronomer of the United States Naval Observatory, he discovered several asteroids, and was a frequent contributor to scientific magazines.

Ferguson, Lady Mary Catharine, Irish writer: b. Stillorgan County, Dublin, Ireland, 1823. She was married in 1848 to Sir Samuel Ferguson (q.v.). She has published 'The Irish Before the Conquest' (1867); 'Life of William Reeves' (1893); 'Sir Samuel Ferguson in the Ireland of His Day' (1896), and edited her husband's works (1887-97).

Ferguson, Patrick, British soldier and inventor of the breech-loading rifle: b. Pitfour, Scotland, 1744; d. King's Mountain, S. C., 7 Oct. 1780. Entering the army in 1759, he served in Germany and Tobago. In 1776 he patented his rifle, firing seven shots a minute, and sighted for ranges of from 100 to 500 yards; and with it he armed a corps of Loyalists, who helped at the battle of Brandywine (1777) to defeat the American army. He himself had a chance there of picking off an officer, but "let him alone, disgusted with the idea of firing at the back of an unoffending individual, who was acquitting himself very coolly of his duty." Next day he learned that the officer was Washington. Three years later, Ferguson fell, defending King's Mountain, S. C., with 800 militia, against 1,300 Americans.

Ferguson, Robert (surnamed "THE PLOTTER"), Scottish conspirator: b. near Alford, Aberdeenshire, about 1637; d. 1714. He went to England about 1655 and in 1662 was ousted as a Presbyterian from the Kentish vicarage of Godmersham. He played for 10 years a leading part in every treasonable scheme against the last two Stuart kings, and twice had to flee the kingdom. But after the Revolution he changed sides, and conspired as busily for the losing Jacobite cause. He wrote: 'History of the Revolution' (1706); 'Qualifications Requisite in a Minister of State' (1710); etc. See James Ferguson, 'Ferguson the Plotter' (1887), ibid. 'Two Scottish Soldiers' (1888).

Ferguson, SIR Samuel, Irish poet: b. Belfast, Ireland, 10 March 1810; d. Howth, Ireland, 9 Aug. 1886. In early life he was a prominent member of the Irish bar; in 1867 was appointed deputy keeper of the public records of Ireland; and in 1878 was knighted in recognition of his antiquarian and literary accomplishments. He will best be remembered as the author of the stirring poem, 'The Forging of the Anchor,' which first appeared in 'Blackwood's Magazine.' Chief among his other publications are: 'Lays of the Western Gael' (1864); 'Congal' (1872), a poem in five books; 'Poems' (1880); 'Shakespearean Brevities' (1882).

Fergusson, Arthur Walsh, American linguist: b. Benicia, Solano County, Cal., 4 Dec. 1859; d. Manila, P. I., 29 Jan. 1908. He was graduated at St. Augustine College, Benicia, in 1877, and at the Georgetown University Law School in 1885. In 1889 he became official interpreter of the American conference at Washington. Subsequently he was secretary of the International American Monetary Commission in 1891; official interpreter of the Intercontinental Railroad Commission in the same year; secretary of the United States Chilean Claims Commission in 1893; secretary of the United States and Venezuelan Claims Commission in 1894; chief translator of the Bureau of American Republics in 1897; official interpreter of the American and Spanish Peace Commission at Paris in 1898; and Spanish secretary of the United States Philippine Commission in 1900.

Fergusson, James, Scottish writer on architecture and archæological subjects: b. Ayr, Scotland, 22 Jan. 1808; d. London 9 Jan. 1886. He went to India as partner of an important commercial house, started an indigo factory on his own account, and after some years retired from business to devote himself to the study of architecture and early civilizations. In 1845 he published 'Illustrations of the Rock-cut Temples of India'; in 1849, 'A Historical Enquiry Into the True Principles of Beauty in Art'; in 1851, 'The Palaces of Nineveh and Persepolis Restored'; in 1855 'Illustrated Hand-book of Architecture'; in 1862, 'History of the Modern Styles of Architecture,' a sequel to the hand-book, both being afterward combined in his 'History of Architecture in All Countries, From the Earliest Times to the Present Day' (1865-7), and completed by a 'History of Indian and Eastern Architecture' (1876). He also wrote 'Fire and Serpent Worship'; 'Rude Stone Monuments in All Countries.' He ranks among the foremost writers upon architecture.

Fergusson, Robert, Scottish poet: b. Edinburgh 17 Oct. 1750; d. 16 Oct. 1774. He became clerk in a law office, and wrote poems both in pure English and in the Scottish dialect, the latter being much superior to the former. His best productions display a rich fund of natural humor, keen powers of observation, and an excellent command of language. He was buried in the Canongate churchyard, Edinburgh, where Burns erected a monument to the memory of this kindred genius. His 'Poems' first appeared in 1773, and have been often reprinted.

Fergusson, Sir **William,** English surgeon: b. Prestonpans, Scotland, 20 March, 1808; d. London 10 Feb. 1877; and educated at Edinburgh University. Sir William was one of the leading consulting surgeons in Europe, the author of 'A System of Practical Surgery,' and the inventor of numerous surgical instruments embodying ingenious improvements. He was created a baronet in 1865, "in consideration of distinguished merit and eminence as a surgeon."

Feriæ, fē'ri-ē, in ancient Rome, public holidays, during which all labor ceased, and all judicial and political proceedings were suspended. The feriæ were divided into two classes, general holidays and private holidays, observed by certain families or individuals. On these days the temples were visited, and prayers and sacrifices offered.

Feringhee, or **Feringee,** fe-ring'gē, the name given by the Hindus to the English and other Europeans. The word is intended to be disrespectful rather than complimentary.

Ferino, Pierre Marie Barthélemy, pē ār mā rē bar tāl mē fā rē'nō, Count of, French general: b. Caravaggio, Lombardy, 1747; d. Paris 28 June 1816. Having entered the Austrian army, he served in the Seven Years' war, but being unjustly treated by the Austrian government, went to France in 1789, and rose to prominence in the French army. The courage which he displayed at the defense of the bridge of Hüningen procured for him the rank of grand-officer of the Legion of Honor (1804), as well as the title of senator. In 1808 he was made a count. Having voted for the deposition of Napoleon, Ferino received from Louis XVIII. the cross of St. Louis, as well as letters of naturalization, which in consequence of the separation of Lombardy from France had become necessary in order to entitle him to sit in the new chamber of peers. The name of this general is written on the east side of the triumphal *Arc de l'étoile.*

Fermanagh, fĕr-man'a̤, an inland county, in the province of Ulster, Ireland; area, 714 square miles. The county is divided lengthwise into two nearly equal portions by Lough Erne. The principal towns are Enniskillen and Fermanagh. Its port is Ballyshannon. Pop. 65,300.

Fermat, Pierre de, pē ār de fār mā, French mathematician: b. Montauban 1601; d. Toulouse 12 Jan. 1665. He was engaged in his youth with his friend Pascal in very profound investigations as to figured numbers, on which he afterward founded his calculation of probabilities, of which he may be considered the inventor. He also devoted particular attention to the general theory of numbers, and made many important discoveries in regard to it, far outstripping any of his predecessors; he squared the parabola in a much simpler way than Archimedes had done, and contributed greatly to the progress of geometry. His method of finding the greatest and least ordinates of curve lines is closely analogous to the method of the differential calculus, then unknown. He carried on a keen controversy with Descartes, whose 'Geometry and Optics' were at variance with his 'Theoria de Maximis et Minimis.' Letters of his, written in 1636, prove that he was acquainted with the method of representing curves by equations before the publication of the 'Geometry' of Descartes, hence M. Libri has declared that he shares with Descartes the honor of having invented the mode of applying algebra to geometry. His collected works were published after his death, under the title of 'Varia Opera Mathematica' (1679).

Fermat's Last Theorem, the celebrated proposition that the equation $X^n + Y^n = Z^n$ cannot be satisfied by integral values of X, Y, and Z, and when n is an integer greater than 2. It was stated, though without proof, by the French mathematician Pierre de Fermat, about 250 years ago. Proofs have been found for many other remarkable theorems in the theory of numbers that were given by Fermat in the same manner, but this one has resisted all attempts at demonstration. There is no sufficient reason to believe it false, and it has indeed been proved to be true for every value of n from 3 up to about 97, and also for many special values greater than this; but no general proof, valid for all values of n, has yet been given. Many interesting things about the equation have been established, however. It is true for n, for example, if it is true for any factor of n; and this has led mathematicians to limit their study of it to the case in which n is a prime number. When n is prime, it is easy to show that the equation cannot be satisfied if any one of the three numbers X, Y, and Z is prime. It is also easy to show that when n is prime there is no solution unless $X + Y - Z$ is divisible by n. Many other similar properties are also known, but the general demonstration of the proposition does not appear to be possible by any of the methods with which mathematicians are now familiar.

Ferment Oils, in chemistry, volatile oils produced by the fermentation of various plants, not originally contained therein, and different from the oils which are extracted from the unfermented plants by distillation with water. They were known to the alchemists, and by them designated quintessences. Ferment oils are for the most part more soluble in water than ordinary volatile oils.

Fermentation (from Lat. *fermentare,* from *fervere,* to boil), a term whose meaning has undergone considerable changes at different times in consequence of the progress of chemistry and biology. By the alchemists it was often used to describe any reaction accompanied by boiling or effervescence, even when purely inorganic, but among older meanings that which comes nearest to its present signification has reference to its use to describe such familiar but mysterious processes as the transformation of grape-juice into wine, the formation of alcohol from the saccharine fluids prepared from cereals, and the raising of the dough in bread making. Closer examination has shown that these processes are only a few out of many of a similar kind, and now all such processes are included under the name fermentation. In its present sense it may be defined as including all chemical changes brought about through the agency, immediate or at least apparently immediate, of micro-organisms or of organic substances immediately derived from the vegetable or animal kingdom, these substances remaining essentially the same after the reaction as they were before it. The organism or substance which produces the fermentation is known as a *ferment,* and in accordance with the foregoing definition ferments may be divided into two main groups, namely, (1) organized or formed ferments, and (2) unorganized, unformed, or soluble ferments, usually called *enzymes.* Both kinds are nitrogenous organic bodies of somewhat unstable character, and in both cases the amount of ferment required to transform a given amount of the fermentable substance is relatively very small. The organized ferments are, however, living bodies of microscopic size belonging to the groups of fungi and bacteria, and are therefore capable of growth and reproduction, while the enzymes are lifeless substances of definite chemical composition. The action of the enzymes, accordingly, is often separated from that of the organized ferments and not included under the term fermentation, but the present state of our knowledge does not seem to offer sufficient warrant for such a course.

The enzymes or unorganized ferments play an important part in the vegetable and animal kingdoms. Thus, the solid, insoluble reserve materials stored up in the seeds, roots, underground stems, and other parts of plants are by their means transformed into soluble substances capable of being diffused throughout the plant-body. These enzymes are of protoplasmic origin, and are complex proteid compounds. The exact nature of their action is unknown, but all, or nearly all, produce their changes by a process known as *hydrolysis,* the nature of which may be best elucidated by citing a particular instance, the action of the enzyme *invertase* or *invertin* (see below) on cane-sugar. The molecule of cane-sugar under the influence of the ferment takes up a molecule of water, which becomes *fixed,* that is, incorporated with it, and then the combination resolves itself into the two simpler sugars, dextrose and levulose. The equation is as follows: $C_{12}H_{22}O_{11} + H_2O = C_6H_{12}O_6 + C_6H_{12}O_6$. The enzyme remains apparently unchanged, and a very small quantity of it seems capable of transforming an indefinite amount of the substance on which it acts. In one case, however, it has been proved that the enzyme forms a compound with the fermentable substance, and that the final products, including the enzyme, are then produced by the solution of this compound in water. This is probably the mode of action in all cases, and it is certainly much more intelligible than the former explanation by *catalytic* or contact action. The optimum temperature for most enzymes is between 85° and 120° F., and they are most active in the dark. The best-known enzyme is *diastase,* which is present in malted grain and converts starch into maltose and dextrin. Other enzymes are: *invertase,* already referred to; *cytase,* which acts chiefly on the cellulose of the cell-walls of grain and other seeds; *inulase,* which transforms inulin into levulose in various bulbs and tubers; *emulsin,* which decomposes the glucoside amygdalin of many rosaceous plants into glucose, benzoic aldehyde, and hydrocyanic acid; *pepsin,* found in gastric juice; *trypsin,* secreted by the pancreas; *zymase,* to which the alcoholic fermentation has been ascribed; and *urase,* to which the fermentation of urea into ammonium carbonate is primarily due.

The organized ferments, or micro-organisms concerned in fermentation, all belong to the group of cryptogamic plants known as Fungi, and their near allies the Bacteria. The most highly organized members of this group concerned in fermentation are some of the molds, but their part in fermentation is of little importance, and we need not further consider them. We may therefore discuss the micro-organisms of fermentation under the two heads: (1) Saccharomycetes, or Yeast-Fungi, and (2) Schizomycetes, or Bacteria. The Saccharomycetes are minute unicellular plants of an oval shape, surrounded by a cell-wall and containing granular protoplasm in which several vacuoles are conspicuous. They reproduce themselves by gemmation or budding, and by this means chains of cells closely resembling the hyphæ of a mycelium are formed; but very few species develop any true mycelium, such as we find in the molds and other fungi. The Bacteria, Schizomycetes, or Fission-Fungi, are a very important group of microscopic cryptogams usually classed with the fungi. Their importance arises not only from the part they play in fermentations, but also from their widespread activity in the order of nature, and especially from their action in producing numerous zymotic diseases in man and other animals. See BACTERIA.

The yeast-fungi cannot assimilate free nitrogen, but they can extract it from salts of ammonia and from various organic bodies. They can take up carbon from sugars, glycerin, tartaric acid, citric acid, acetic acid, ethyl alcohol, benzoic acid, phenol, and other organic bodies; but they can obtain their nutriment only in the presence of such substances as potash, lime, and phosphoric acid. Unlike nearly all the bacteria, the yeasts can live in acid media if the acid be not present in excessive quantity. The presence of free oxygen is very favorable to the growth of yeast-fungi, but under these conditions the transformation of sugar into alcohol greatly diminishes in vigor. If, however, free oxygen be excluded, fermentation proceeds vigorously. The optimum temperature for the growth of yeast-fungi is from 77° to 86° F., and they seem to be quite indifferent to light and electricity. Bacteria assimilate nitrogen most readily from peptone, but many other substances can also yield. Carbon is most readily taken up from sugars, glycerin, tartrates, citrates, lactates, acetates, etc. Most bacteria are unfavorably influenced by light, and in respect to temperature there is a great diversity among the different species, some flourishing at 60° to 70° C. and others at freezing point, but for several of the best-known species the optimum temperature is 25° to 35° C. The *obligate aërobic* forms cannot live in the absence of free oxygen, while the *obligate anaërobic* kinds are destroyed by the smallest trace of free oxygen. Between these two extremes we have *facultative aërobic* species, which are generally anaërobic, but can tolerate some free oxygen, and *facultative anaërobic* species, generally aërobic but able to live when the free oxygen is much diminished. Phosphoric acid, potash, lime, and similar bodies are necessary to their growth.

The most important of all fermentations due to Saccharomycetes is that by which alcohol is obtained from sugar (the sugar itself being largely that derived from the starch of barley or other cereal), and it is in connection with this process that the subject has been most thoroughly studied. The species of fungus or yeast used in this process is known as *Saccharomyces cerevisiæ*, but of this two kinds are distinguished, namely, *top yeast and bottom yeast*. The former is used in top fermentation, which is carried on at a rather high temperature (60° to 85° F.) and is rather violent, carbon dioxid being freely evolved and carrying the yeast to the surface. Bottom yeast is used in the slower bottom fermentation at about 40° to 50° F., in which carbon dioxid is more gently evolved and the yeast therefore remains at the bottom. Bottom fermentation is chiefly used in the manufacture of lager beer. The sugars directly fermentable by this process are those with the formula $C_6H_{12}O_6$, namely, dextrose, levulose, and galactose. Cane-sugar ($C_{12}H_{22}O_{11}$) is first changed by an enzyme *invertase* (see above) contained in the yeast into dextrose and levulose, which are then fermented. The chief products of the fermentation are alcohol and carbon dioxid, but other bodies, such as glycerin, succinic acid, propyl, amyl, and other higher alcohols, are also produced. The process of fermentation continues until the alcohol forms about 14 per cent of the solution, when the yeast-plant cannot continue its action any longer.

Many theories of alcoholic fermentation have been advanced. Lavoisier, treating sugar as an oxid, thought that it was chemically resolved by fermentation into two other oxids, carbon dioxid and alcohol. When the organic nature of yeast was proved beyond doubt, the physiological theory was advanced, according to which the sugar is the food of the plant and the products of fermentation are its excretions. The celebrated chemist Liebig, however, contended that fermentation was a purely chemical process, and his later opinion has been in part reverted to by more recent observers. Pasteur proved conclusively that fermentation was bound up with the life of the organisms, but in what manner is still uncertain. Traube regarded the cells as centres for the production of enzymes, thus reducing fermentation by organized ferments to that produced by unorganized ferments. Traube's theory has gained considerable ground lately on account of the successful extraction from yeast by Buchner of an enzyme, *zymase*, which can produce all the phenomena of alcoholic fermentation.

The chief micro-organism of the vinous fermentation is *S. ellipsoïdeus*. The elliptical cells of this species are found on the grapes and in the air of grape-growing districts, and fermentation is thus set up spontaneously without the actual addition of yeast. Recently pure cultures of the wine-yeast have been prepared and used with very good results in the fermentation of grape-juice. E. C. Hansen, an able Danish investigator, has added greatly to our knowledge of the chief yeast-fungi, and has prepared and thoroughly examined several pure cultures of the three most important species, *S. cerevisiæ*, *S. pastorianus*, and *S. ellipsoïdeus*. He has described six kinds in all, two belonging to the last species, three to the second, and the sixth to the first, the distinctions being founded on the temperature of spore-formation and the conditions under which a surface film forms in a liquid medium. Hansen has also cultivated two pure forms of brewers' yeast, known as Carlsberg No. 1 and No. 2. Both are bottom yeasts, but the beer produced by No. 1 has less carbon dioxid than that of No. 2, and is used chiefly for bottling, the No. 2 beer being preferred for export.

Of the fermentations set up by bacteria only some of the most important can be referred to here. (1) *Acetic Acid Fermentation*. In this fermentation alcohol becomes oxidized into acetic acid, the total reaction being representable by the equation:

$$C_2H_5OH + O_2 = C_2H_4O_2 + H_2O.$$

The microbe concerned in the fermentation, if allowed to continue its action, will oxidize the acetic acid into carbon dioxid and water. Two bacilli, namely, *Bacillus aceti* and *B. pasteurianus*, have been described as taking part in this important fermentation, which is the basis of the commercial manufacture of vinegar from wine. (2) *Lactic Fermentation*. The souring of milk which has stood for some time is due to this fermentation, by which the milk-sugar becomes transformed into lactic acid through the agency of bacteria. Carbon dioxid is an invariable product of the fermentation. (3) *Butyric Fermentation*, often set up in milk which has undergone the lactic fermentation. (4) *Nitrification of Ammonia*, a process of vital importance in nature, by which organic nitrogen becomes fixed in soils as nitrates and nitrites. The process of decay and putrefaction, with the production of *ptomaïnes*, also belong to this section of the subject of fermentation.

(See ALCOHOL; BREWING; DISTILLED LIQUORS; VINEGAR; WINE; etc.) Among treatises on the subject the following may be mentioned: A. Jörgenson, 'Die Mikroorganismen der Gärungsindustrie,' translated into English by H. T. Brown as 'The Micro-organisms of Fermentation'; Schützenberger, 'Fermentation'; Trouessart, 'Microbes, Ferments, and Moulds.'

Fermented Liquors. See DISTILLED LIQUORS.

Ferments, agents in causing fermentation; these may be either organized or unorganized. The former belong to microscopic fungi of the lowest order. The latter are sometimes called chemical ferments, as they bring about chemical changes in other substances, with which they are brought in contact, without themselves undergoing a permanent transmutation.

Fermo, fĕr'mō (ancient FIRMUM PICENUM), Italy, city in the province of Ascoli Piceno, 32 miles south-southeast of Ancona. It was founded by the Sabines before Rome existed; and has remains of old walls. It gives name to an archiepiscopal see, and has a cathedral, several other churches, a town-house, part of which dates from the 14th century; collections of statuary and paintings. Its harbor is situated on the Adriatic, about three miles distant. Pop. 15,000; of the commune, 20,542.

Fermor, Henrietta Louisa, COUNTESS OF POMFRET, English writer: d. 15 Dec. 1761. Her letters were published in 'Correspondence between Frances, Countess of Hartford (afterward Duchess of Somerset), and Henrietta Louisa, Countess of Pomfret, between . . . 1738 and 1741' (1805).

Fermoy, fĕr-moi', Ireland, town, in the county of Cork, 22 miles north-northeast of the city of Cork, on the Blackwater. On the river opposite to the town are infantry, artillery, and cavalry barracks, accommodating about 3,000 men. There are here Fermoy College, St. Coleman's Roman Catholic College, two convents, and a handsome Roman Catholic cathedral. It has some large flour-mills and a brewery. Pop. 6,469.

Fern, Fanny. See Parton, Sara Payson Willis.

Fern, Male (*Dryopteris filix-mas*), a native fern of the northern part of the United States and of Europe, Asia, Africa and South America. In medicine the rhizome is used. It contains an active oleoresin, the most important constituent of which is filicic acid, and is a very efficient remedy for the treatment of tapeworm, particularly of the genus *Tænia*. Other American species of the same genus, *D. marginale, D. goldianum,* contain small amounts of the same oleoresin as that found in male fern, and can be used for much the same purposes.

Fern-owl, the common British nightjar (*Caprinmulgus europæus*), which goes by many other provincial names, as "goat-owl" and "churn-owl," due to the noises it makes and an erroneous supposition that it is a kind of owl. Consult White's 'Selborne'; and see Nightjar.

Fer'nald, Charles Henry, American zoologist: b. Mount Desert, Maine, 16 March 1838. He was an acting ensign in the United States navy during the Civil War; and professor of natural history at the Maine State College in 1871-86. In the latter year he was appointed professor of zoology at the Massachusetts Agricultural College. His publications include: 'Tortricidæ of North America'; 'The Crambidæ of North America'; 'The Pterophoridæ of North America'; 'Pyralidæ of North America'; etc.

Fernald, Chester Bailey, American writer: b. Boston, Mass., 18 March 1869. He is author of: 'The Cat and the Cherub, and Other Stories' (1896); 'Chinatown Stories' (1899); 'The Moonlight Blossom' (1899), a drama; etc.

Fernald, James Champlain, American Baptist clergyman and author: b. Portland, Maine, 18 Aug. 1838. He was graduated at Harvard 1860, and at Newton Theological Seminary 1863, and was ordained to that ministry 1864. He settled in Ohio, holding pastorates in Granville and Springfield; removing to New York in 1889. He has since done much editing and writing, having been editor of 'Synonyms,' 'Antonyms,' and 'Prepositions in the Standard Dictionary' and editor-in-chief of the 'Student's Standard Dictionary,' and of the 'Homilitic Review.' Among his works are: 'The Economies of Prohibition'; 'The New Womanhood'; 'Synonyms, Antonyms, and Prepositions of the English Language'; 'The Spaniard in History' (1898); 'The Imperial Republic' (1898); 'Training of Children' (1898); 'True Motherhood' (1900).

Fernandez, Juan, hoo ăn' fĕr năn'deth, Spanish navigator and explorer: b. probably Cartagena, Spain, 1536; d. Ligna, Chile, 1602. In sailing between the ports of South America he stood out to sea, benefiting by the trade winds and thus shortening the time of the voyage, for which he narrowly escaped condemnation as a sorcerer. He discovered the island which was named after him 1563, and tried to establish a colony there, but failed in this enterprise. He also discovered the islands of St. Felix and St. Ambrose 1574. The sojourn of Alexander Selkirk upon the island of Juan Fernandez probably suggested 'Robinson Crusoe' to Defoe.

Fernandez, Leandro, Mexican statesman: b. in the state of Durango, 27 Feb. 1851. He was educated at the Juarez Institute at Durango and the School of Engineers, Mexico City, adopting engineering as his profession. Was given the title of 'assayer' in 1873 and 'engineer' in 1876. Was 'official mayor' of the department of communications for 19 months, then successively director of the government mint at Mexico City six and a half years; governor of Durango one year; and secretary of Fomento more than two years. He has also been director of the National Astronomical Observatory and professor in and director of the National School of Engineers, Mexico City. He was appointed secretary of communications and public works in 1904.

Fernandez de Cordova, Diego, dē-ā'gō fĕr-năn'deth dā kor'dō-vä, marquis of Guadalcazar, Spanish statesman: b. Cordova about 1580; d. after 1629. He was made viceroy of Mexico in 1612, holding the office till 1621. He founded the cities of Lerma, Cordova, and Guadalcazar, completed the Mexican aqueduct and was viceroy of Peru from 1622-29.

Fernandez de la Cueva, Francisco, frän-sîs'cō fĕr-năn'deth dā lä kwā'vä, duke of Albuquerque, Spanish statesman: b. about 1610. He was appointed viceroy of Mexico 1653, holding the office until May 1661. During his term the city of Mexico was greatly developed and the cathedral constructed. His later years were spent as viceroy of Sicily.

Fernandez y Gonzalez, Manuel, mä-noo-äl' fĕr-năn deth ē gōn thä leth, Spanish poet and novelist: b. Seville, Spain, 1830; d. Madrid 6 Jan. 1888. A boyhood in Granada and seven years' army service afforded him varied experience of life and men. From 1846 he gave himself to literature; and the plays, 'Struggling Against Fate' (1848); 'The Cid' (1858); 'A Duel on Time' (1859); 'Imperial Adventures' (1864), well constructed and full of humor, won great popularity. Among his novels are: 'The Seven Children of Lara' (1862); 'The Bloody Queen' (1883); 'The Plantagenet Brothers' (1889). A volume of his poems appeared in 1858.

Fernandez-Lizardi, José Joaquin, hō-sā' hōä-kēn' fĕr-năn'deth-lē-thär'dē, Mexican novelist: b. City of Mexico 1771; d. there June 1827. His most famous work is 'Periquillo Sarniento' (1816, new ed. 1884). He also published two novels, 'Sad Nights and Gala Days' (1823), and 'Life and Exploits of the Famous Knight Don Catrin de la Facheuda' (1832).

Fernandez Madrid, Jose, hō-sā' mä-thrēth fĕr-năn'deth, Colombian poet and statesman: b. Cartagena, Colombia, 9 Feb. 1789; d. near London, England, 28 June 1830. He was for a short time president of his country in 1816, but was afterward exiled to Cuba where for nine years he was prominent as a physician. In 1825 he was sent by Bolivar as minister to England. He published a volume of poems: 'The Roses' (1822); also two tragedies, 'Atala' (1822), and 'Guatimozin' (1827).

Fernandez Navarrete. See Navarrete, Juan Fernandez.

Fernández, de Palencia, Diego, dē-ā'gō dā pā-lĕn'thē-ā fĕr-nän'deth, Spanish-American historian: b. Palencia, Spain, about 1530; d. Seville 1581. He was apparently a soldier of fortune, lured to the scene of Pizarro's great conquest in the hope of fabulous wealth. He had some fighting experiences, and wrote: 'The First and Second Parts of the History of Peru' (1571), a narrative of the subjugation of the Incas.

Fernandez de los Rios, Angel, än-hāl' fĕr-nän'deth dā lōs rē'ōs, Spanish writer: b. Madrid, Spain, 27 July 1821; d. 1879. Active in politics and political journalism at home, he was banished, and became a man of letters in Paris. He wrote: 'All or Nothing' (1876), an anti-Bourbon prose study of social conditions; 'A Week in Lisbon' (1876); and many essays of value on the politics and resources of the Peninsula.

Fernandina, fėr-nan-dē'na, Florida, city, port of entry, and county-seat of Nassau County, on Amelia Island, Amelia River, and the Florida C. & P. R.R.; 33 miles north by northwest of Jacksonville. Its manufactures are lumber, canned oysters, plastering fibre (made from palmetto), and cotton goods. It exports cotton, phosphates, lumber, plastering fibre, and canned goods. It is a favorite winter resort. A shell road leads to Amelia Beach, and nearby is Cumberland Island, the home of Gen. Nathaniel Greene (q.v.). Pop. (1910) 3,482.

Fernando de Noronha, fĕr-nän'dō dā nō-rōn'yä, an island, of volcanic origin, in the South Atlantic, belonging to Brazil; area, about 12 square miles. It has a rugged, mountainous, wooded surface. It is used as a penal settlement for Brazilian male criminals.

Fernando Po, fėr nan' pō (Span. fĕr nän'dō pō'), an island belonging to Spain, in the Bight of Biafra, 20 miles from the West African coast. It is of volcanic origin, about 40 miles in length by 20 miles in breadth. It is mountainous and covered with dense forests of valuable timber, while the land gradually rises from the steep and rocky coasts into two peaks culminating upward of 10,000 feet above sea-level. It is well-watered, and sugarcane grows in abundance. Yams form the staple food; birds and fish are plentiful. The climate is very unhealthy. The capital is Clarence Cove. This island was discovered in 1471 by the Portuguese, who ceded it to Spain in 1778. The Spaniards eventually abandoned it, and the British, in 1824, selected it as a suitable military depot and naval station. They, in their turn, abandoned it in 1834, on account of its unhealthfulness. The Spaniards again took possession in 1844. It is now used by them as a penal settlement, to which, in 1869, several Cuban patriots were deported, as political prisoners.

Ferne Islands. See FARNE ISLANDS.

Ferney, or Fernex, fār-nā, France, town in the department of Ain, about five miles north of Geneva. It is small, and its only manufactures are watches and pottery. It is chiefly noted for having been the chief residence of Voltaire (who in fact founded it) from about 1760 to 1778. The house in which he lived is still standing, and the church, with the inscription, '*Deo erexit Voltaire,*' is now a farmhouse. Pop. 1,189.

Fernkorn, Anton Dominikus, än'tōn dō-mi-ni-koos' fĕrn'korn, Austrian sculptor: b. Erfurt, Saxony, 17 March 1813; d. Irrsin, near Vienna, 16 Nov. 1878. He studied under Stiglmayer and Schwanthaler 1836–40, and attracted attention by his first group, 'St. George and the Dragon,' the Austrian government then appointing him director of the Imperial bronze foundry at Vienna, where he executed his masterpiece, a colossal statue of Archduke Karl 1860, and his statue of Prince Eugéne 1865. Among his other works are a colossal bust of Radetsky; a marble statue of the poet Frederick Heffel, and a monument of Ressil.

Fer'now, Bernhard Eduard, American scientist: b. Inowraclaw, Germany, 7 Jan. 1851. He was educated at the University of Königsberg; removed to the United States in 1876 and engaged in metallurgical work; and was chief of the division of forestry in the United States Department of Agriculture in 1886–98. In the latter year he was made director and dean of the New York State College of Forestry at Cornell University. He is the author of 'The White Pine' (1899); 'Report Upon Forestry Investigations of the United States Department of Agriculture 1877–98' (1899); etc.

Fernow, Berthold, American author: b. Inowraclaw, Germany, 28 Nov. 1837. He entered the Prussian army and became lieutenant in 1860. He soon after removed to the United States; became a private in the 4th Missouri Cavalry in 1862; and was promoted lieutenant of the 3d United States Colored Infantry in 1863. He was archivist of New York State in 1876–89. He has written 'Albany and Its Place in the History of the United States' (1886); 'Ohio Valley in Colonial Days' (1889); etc., and edited 'Documents Relating to Colonial History of New York' (Vols. XII., XIII., XIV.); 'New York in the Revolution' (1887); and 'Records of New Amsterdam' (1897).

Ferns and Fern-allies. The ferns are representatives of an extensive branch of the plant world technically known as *pteridophytes,* standing between the mosses and hepatics (*bryophytes*) on the one hand and the cycads and conifers (*gymnosperms*) on the other, at the head of the now obsolete subdivision of plants known as cryptogams. They resemble the former groups so closely in their method of sexual reproduction and in showing alternating phases of growth that both mosses and ferns are often united under a single primary division of plants as *archegoniates,* so called from the common possession of a structure described below as the archegone. The ferns differ from the mosses in their highly developed vascular or woody system seen in the fibrous strands of the leaf-stalks and the veins of the leaves, and so are still sometimes called vascular cryptogams. Besides the ferns, popularly so known, there are various groups of plants closely allied to ferns which with them make up the branch pteridophytes. Among these fern-allies are the running-pine or ground-pine, familiar in its use for Christmas decoration, the selaginellas frequent in cultivation, the field horsetail, and the scouring-rush. These will be treated in their proper sequence below.

The mature fern-plant, which may stand as a representative pteridophyte, consists of a woody axis bearing scattered or clustered leaves according as this axis is a creeping structure or an upright trunk. In our northern species this axis is either below the surface of the ground or just at the surface, but in some of the species of tropical regions it often forms a trunk from one foot to fifty feet in height, or even more, bearing its leaves at the summit and forming a tree-fern.

On the under surface of certain leaves of ordinary ferns little clusters of stalked bodies (*sporangia*) appear, which are variously arranged in different species, in rounded or linear masses (*sori*) or in a few species are scattered over the surface of the leaf. These structures consist of a membranous wall enclosing minute bodies — the fern-spores. These are the reproductive bodies of the fern asexually produced by repeated division of the interior portion of the young sporangium, and are often popularly known as "fern-seeds." This is a misnomer, for they rather find their homology with the pollen-grains and young embryo-sacs of the higher plants. In the sporangia of some ferns a series of peculiar cells serves the purpose of rupturing the sporangium wall, and by an elastic movement scatters the spores at some distance from the plant producing them. Either at once or after a period of rest the fern-spore sprouts and produces a green hepatic-like structure known as a prothallus. This is a flat expanse of soft green tissue, usually more or less heart-shaped, and ranging up to a half inch or more in diameter. It forms root-hairs beneath, and grows exactly like an ordinary new plant. On its under surface among the root-hairs two sorts of structures are produced: (1) A series of rounded bodies known as antherids, in which minute motile cells are formed known as antherozoids, these being the male or sperm cells connected with the sexual reproduction of the fern; (2) a series of flask-shaped bodies (archegones) more deeply imbedded in the tissues of the prothallus, which contain a single specialized cell at the bottom of the flask, known as the egg, this being the female reproductive cell. The sperm-cells escaping from the antherid swim in the delicate film of moisture which may bathe the surface of the prothallus, swarm about the mouth of the archegone, and one of them enters the neck of the flask-like structure, penetrating the mucilaginous contents of its tube, and fuses with the egg, thus effecting a true sexual reproduction. The fertilized egg soon commences division, increases in size, and develops a primary root and leaf, ultimately growing into a new fern-plant. The two alternating phases of growth in the life period of the fern are thus strongly marked; the sexual phase (prothallus) is often known as the gametophyte, and the asexual phase (the fern-plant) which follows is known as the sporophyte or spore-producing phase.

In some of the fern-allies like *Marsilea* and *Selaginella* the plants produce two kinds of spores, (1) microspores, which develop into prothalli producing only antherids, and (2) macrospores, which develop into prothalli producing only archegones. In these plants, particularly *Selaginella*, the prothallus is much reduced in size, and the sexual reproduction approaches that of the pines and other conifers, except that it takes place away from the plant producing the spores. The microspores of *Selaginella* are thus the exact counterparts of the pollen-grains of the pine, and the macrospores correspond to what is known as the embryo-sac in the young pine-cone, to that part of the ovule in which the egg-apparatus appears, and in which the seed is ultimately developed.

Ferns are distributed all over the world but diminish in the number of species, in the profusion of individuals, and in the relative proportion to the total vegetation of the locality as we pass from tropical to polar regions. Moist insular climates are best adapted to their development. Java has 575 species of ferns, while New York State with about the same area has scarcely one tenth as many. Jamaica, with about the area of Connecticut, has nearly 500 species; Hawaii, Samoa, New Zealand, and the Philippines are other prolific regions. While moist conditions favor fern-growth and development, certain species have adapted themselves to dry climates and grow on open exposed rocks of semi-arid regions. Such ferns are provided with woolly hairs, tangled scales, waxy powder or other mechanical contrivances to conserve their moisture. One species of the so-called "resurrection-plants" (*Selaginella lepidophylla*) of the arid regions of the southwest conserves its moisture during the dry season by coiling its branches inward so as to form a compact ball. On the return of moisture it flattens out and exposes its fresh green surface. The "resurrection-fern" curls up in a similar way, its under surface being protected by a layer of scales. It grows on trees in the southern States and the West Indies.

The ferns of temperate regions are terrestrial in their habit, but as we approach the tropics a large number become epiphytic, growing with mosses and orchids on the trunks and branches of trees. The filmy ferns frequently cover the trunks of tree-ferns completely.

There are over 5,000 described species of pteridophytes in the present flora of the world, which are grouped according to their characters under seven distinct orders. Of these we have nearly 290 species within the limits of the United States.

Geologically, the pteridophytes are a very old group dating back to the Devonian and reaching their first culmination during the Carboniferous Age, in which they formed the bulk of the vegetation of the coal-measures. Besides ferns, some of the fern-allies of those times attained very great size, as shown in the giant trunks of *Lepidodendron* and *Sigillaria*, related to the modern club-mosses, and in the large stems of *Calamites*, related to our present diminutive scouring-rushes. The various types of the modern pteridophytes and their distinctive characteristics will be treated under their respective orders, arranged, as nearly as a lineal series can show it, in their relative rank in the scale of vegetable life.

I. *Ophioglossales.*— The adder-tongues and grape-ferns are eusporangiate; that is, their sporangia develop from the interior tissues. They include plants of a fleshy texture, bearing their thick-walled sporangia in spikes or panicles. The prothallus, so far as known, is subterranean and colorless. We have in the United States seven species of adder-tongue (*Ophioglossum*), and 17 species of grape-ferns (*Botrychium*), the former having the sporangia in spikes and the latter having them in panicles. All our northern species are terrestrial plants with fleshy roots. *Cheiroglossa palmata* of Florida and the West Indies is a hanging epiphyte growing on palmetto-trunks and on other trees, and the curious strap-like *Ophioderma* of Hawaii and other Pacific isles grows in similar situations, with its pendant leaf from two to five feet long. The order *Ophioglossales* represents the simplest type of fern-growth in existence, and probably the oldest type as well. The species (about 60) are not numerous, but are very widely distributed.

II. *Marattiales.*— This order includes only tropical ferns of a coarse habit, ranging from two feet to ten feet in height. They are eusporangiate like the last order, but have the coiled-bud form of the true ferns. They also bear their sporangia dorsally, that is, on the under surface of the leaf, but these are formed in special boat-like receptacles known as synangia. *Marattia* and *Danæa* are the two principal genera. Two species of the former and nine of the latter are found in the North American tropics. The order is a smaller one than the last and, like it, consists of a single family.

III. *Filicales.*— The ferns proper, including nearly 4,000 species, are divided unequally among the eight families of this order. They are leptosporangiate (that is, the sporangia develop from the epidermal tissues), and all produce green prothalli of the type described above. Except the *Matoniaceæ,* a small family of two species, all are represented in America. Two families are tropical only, while the remaining five are also represented in the United States.

1. The flowering ferns, so called because the sporangia are panicled, are among the conspicuous features of our northern swamp vegetation in spring and early summer. The cinnamon-fern grows in great crowns, sending up its spore-producing leaves, which have a rich cinnamon color, a short time in advance of its rich crown of foliage-leaves. The royal flowering-fern grows in similar locations, but is larger, has more compound foliage, and bears its panicle at the summit of the foliage-leaf. The flowering ferns (*Osmunda*), with two genera from New Zealand and Africa, make up the family *Osmundaceæ* with 16 species. In this family the ring of the sporangia is rudimentary and the sporangia open longitudinally.

2. The Hartford fern or climbing fern (*Lygodium*) is the type of a second small family. Our species is low-growing, only two or three feet high, and twines closely about other vegetation. It is quite local, but where it grows it sometimes forms tangles. In Connecticut it is so rare that it is protected by law. The tropical species of this genus often climb trees for 40 feet or more. Another member of the same family is the curious curly-grass (*Schizæa*) of the pine-barrens of New Jersey. It is wholly unlike ordinary ferns, the foliage-leaves resembling curled grass-leaves and the spore-bearing leaf resembling a small sedge. The entire plant is only four or five inches high. These two species with two subtropical species of *Ornithopteris* form our four representatives of the family *Schizæaceæ,* whose 80 species are largely South American, though several species occur in the Old World. They are characterized by their pear-shaped sporangia with an apical ring. The sporangia are usually borne in spikes or panicles.

3. The *Gleicheniaceæ* are found in the tropics of both hemispheres, several species of *Dicranopteris* occurring in the uplands of the West Indies, forming almost impassable tangles or thickets. These ferns, instead of uncoiling at once, produce buds in the axils of the forked branches, and as the lower portions mature these buds develop successive upper growths. The tangles thus formed are often sufficient to bear the weight of a man, and it is possible to walk for some distance on these thickets.

4. The floating-fern (*Ceratopteris*), found rarely in Florida and Louisiana, and occasionally throughout the tropics of both hemispheres, is almost the only aquatic representative of the order. Its sterile leaves float on the surface of shallow waters, and its pad-like fertile ones project above the surface. The name *Ceratopteris* is derived from this fertile leaf, which branches like a deer's horn, and gives the name to the family *Ceratopteridaceæ.*

5. The tree-ferns of both hemispheres form a separate family *Cyatheaceæ,* though several members of this family are very diminutive, and ferns with trunks occur occasionally in other families. No tree-ferns occur in the United States, but 30 species or more are found in the higher altitudes of the West Indies, and many more occur in other tropical regions. In some portions of the mountains of Jamaica tree-ferns form half or three fifths of the forest vegetation, the trunks ranging from 6 to 50 feet in height. A well-developed tree-fern forms one of the most beautiful types of vegetation, rivaling the palms in grace and perfection of form. Some 200 species have been described, belonging chiefly to the genera *Cyathea, Alsophila, Hemitelia, Dicksonia,* and *Cibotium.*

6. The great mass of our ferns belong to the family *Polypodiaceæ,* often known as the true ferns, perhaps for no better reason than that they were the first to be called by the name of ferns. The members of this family have definitely stalked sporangia, always provided with an elastic vertical ring which causes the sporangium to burst transversely and thus disperses the spores. In some species, like the stag-horn fern, the sporangia are spread over the under-leaf surface in a uniform layer; in others, like the spleenworts and bird's-nest fern, they are in definite lines; while in our common polypody, the maidenhair, and the wood ferns they are in small rounded masses (sori). In some species the sorus is naked, but in most it is covered by a small membrane (indusium), primarily for the purpose of protecting the young sporangia. In some ferns, like the spleenworts, the indusium develops along a vein; in others, like the Christmas-fern, it is attached at one point and covers the sorus like an umbrella; in still others, like the maidenhair, it is formed of a modified portion of the margin of the leaf folded under so as to cover the young sporangium. The nature and position of the indusial covering forms one of the leading characters for the separation of genera under the Hookerian scheme of classification, while the Preslian scheme lays stress on the character of the venation, the fundamental branching of the fibro-vascular system of the plant. A more rational and natural scheme combines with these the habital and biological characters that serve to group in each genus ferns that really have a natural relation to one another.

In so large a group of plants as that presented by this family we must expect to find the greatest diversity of size and structure, dependent on the geographical distribution, the altitudinal distribution, and on the ecological conditions under which the various members of the family have become developed. Marsh, swamp, rocky hillside, cliff and moist ravine each have their characteristic species in every country, while the trees of every tropical region support an extensive epiphytic series which varies with every considerable change of altitude. Even exposed cliffs in semi-arid regions support their own peculiar ferns, which have become adapted to conditions that at first would appear wholly unsuited to fern-growth. Obviously only a few of the more common species which grow wild or in cultivation can be mentioned here.

The sword-fern (*Nephrolepis*), some forms of which are known in cultivation as the "Boston Fern," is a native of tropical America, occurring frequently in peninsular Florida. In its native haunts it is more commonly found on the trunks of palm-trees, though it often grows on the ground or on rotten wood. It is a favorite in cultivation, either in hanging baskets or in jardinières, and requires a rich soil and moist surroundings to thrive best. The sori are provided with a kidney-shaped indusium.

The maidenhairs (*Adiantum*) are perhaps the most graceful of the herbaceous ferns. Over 60 species are known, many of which have long been in cultivation. The luxuriant split-leaved *A. Farleyense* and the numerous fine-leaved varieties of *A. cuneatum and A. gracillimum* are among the most graceful in cultivation. Owing to their readiness to wilt most maidenhairs thrive best in Wardian cases.

In late years Japanese fern-balls have become popular in cultivation, consisting of the slender rootstocks of a species of *Davallia* wrapped about a mass of peat-enclosed soil, and held in form by wires. The Davallias are graceful ferns mostly confined to the Old World, though related genera are found in the American tropics. Numerous species are found in cultivation in the larger conservatories. Among our wild species the ostrich-fern (*Matteuccia*) is one of the best for out-of-door cultivation, to which it readily yields. It grows in graceful crowns from an erect rootstock, and has a bright green color. Its spore-bearing leaves are curiously rolled together so as to have the appearance of pods containing the copious sporangia. It requires a moist soil for its growth, and when growing wild thrives best in low ground. Other ferns suited for bed-cultivation are the graceful wood-ferns (*Dryopteris spinulosa*, and related species) and the Christmas-fern (*Polystichum*), both with dark foliage and crown-like habit, and the hay-fern (*Dennstædtia*) with a foliage of lighter green and a more scattered habit of growth resulting from its creeping rootstocks. The wood-ferns and Christmas-fern are firm in texture, and remain green throughout the winter; the hay-fern dies down with the early frosts. Another delicate pale-green species suitable for cultivation is the New York fern (*Dryopteris Noveboracensis*), which, however, has a range from New England to Alabama.

For rockeries the bladder-fern (*Filix fragilis*), the smaller spleenworts (*Asplenium trichomanes* and *A. platyneuron*), the rock-brake (*Pellæa*). and the curious walking-leaf are common among the best native species; and all thrive best if the rocks are part limestone. The last-named fern has a peculiar habit among our native species, shared, however, by many exotic ferns. The leaf, which is simple and tapers to a slender point from a rounded lobed base, takes root at the apex and forms a new plant, whose leaves may again take root and form still other plants. This peculiarity of taking steps away from the mother plant has given the name walking-leaf to this small fern, whose leaves range from 4 to 10 inches in length.

Aside from decorative value, ferns have little utility. The matted tufts of soft hair-like scales of some of the Hawaiian tree-ferns (*Cibotium*) are collected in commercial quantities and used for filling mattresses under the name "pulu." The male-fern (*Dryopteris filix-mas*) and some of its near allies are used in medicine as a vermifuge, and the soft parts of certain species are used for food. The mission of the fern, however, seems to be an æsthetic one, to minister grace and beautify the duller and more prosaic sides of nature.

7. In point of grace and delicacy none of the ferns as ordinarily known can equal the filmies, which flourish best at the higher elevations of tropical lands. These ferns differ from the true ferns not only in the form of the sporangium, and its attachment to a thread-like receptacle, but also in the texture of the leaf, whose blade is often only a single cell thick, so that the leaf is strongly translucent. Add to this delicacy of texture the most exquisite fineness of cutting and pattern, and place the leaves dripping with diamond dew-drops in masses on trunks of tree-ferns in the midst of a tropical luxuriance, and you have perhaps the nearest approach to a fern-paradise that could be imagined by the most ardent lover of nature. Such a picture can be found in the mountains of Jamaica and in many other tropical islands. The filmy ferns belong chiefly to the genera *Trichomanes* and *Hymenophyllum*, and although many are apparently so simple, the *Hymenophyllaceæ* form one of the most highly differentiated families among the ferns. A few others simulate them in texture, like the delicate New Zealand species of *Leptopteris* and some species of *Asplenium* in the American tropics, but these are representatives of two distinct families. The genus *Loxsoma* represents a structural connecting-link between the genus *Davallia* and the filmy ferns, and this is apparently their only point of kinship. Two species of *Trichomanes* occur under moist rocks in some of our Gulf States, one of them scarcely over a half inch in height.

IV. *Salviniales.*— Next to the ferns are the members of this order, in which spores of two sorts are produced in special conceptacles resembling small pods or spheres. There are two types of habit represented, one series (*Salviniaceæ*) floating on the surface of water, and the other (*Marsileaceæ*) rooting in mud. *Salvinia*, with oval leaves, is occasionally seen in cultivation but is rare in a wild state. *Azolla* is found in great abundance in Florida, sometimes covering the surface of ponds with its delicate branching small-leaved stems. A second species occurs in California. *Marsilea* is the type of the second family, and has a four-parted leaf resembling that of *Oxalis*. It grows on the wet borders of ponds, or if the water becomes high, it elongates its leaf-stalks and the leaves float on the surface like four-leaf clovers. Its conceptacles are oval and are borne on short stalks. One species grows abundantly at Bantam Lake, Connecticut, and others in Florida and in the far Northwest, where they are more common. *Pilularia* is a second genus of the family with thread-like leaves, and spherical pill-like conceptacles. Our single species occurs in California, Oregon, and Arkansas.

V. *Equisetales.*—About 25 species forming a single genus and family make up this order. There are two types of growth, both common species of *Equisetum,* which have received different popular names. One is the field horsetail, which appears in low sandy ground early in spring, sending up a flesh-colored stalk terminating in a cone, followed by the «horsetails,» which are the vegetative parts of the plant, consisting of a central hollow stalk with angular whorled branches. The leaves are reduced to sheaths encircling the stem. Under the surface-shields that cover the cone, the spores, which in mass resemble a fluffy mold, are borne in sporangia. The peculiar appearance of the spores is due to the fact that each is surrounded by an outer covering which splits spirally into four branches arranged cross-like at one end of the spore. These are exceedingly hygroscopic, and they absorb water and coil up at the slightest breath; then uncoiling as soon as the moisture dries, they jostle each other about. The purpose of this mechanism is to scatter the spores gradually from the sporangia at maturity. The second type of *Equisetum* grows on banks with stiff, jointed, rush-like, often clustered stems surrounded at the joints by a light-colored sheath. These also bear cones in late spring similar to those of the field-horsetail. These plants are sometimes called «scouring-rushes,» from the fact that their roughness caused by silica in the epidermis led to their use for scouring floors and woodenware.

VI. *Isoetales.*—This order likewise contains a single genus (*Isoetes*) and family. The plants are aquatic, either growing submerged or on the shores of ponds and rivers. They consist of a short fleshy base, bearing a cluster of leaves which are broadened at the base and contain an axillary sporangium, and end in awl-like joints. The position of the order is problematical, as these obscure plants seem to show unexpected affinities with several other groups. They are eusporangiate and produce spores of two sorts.

VII. *Lycopodiales.*—This order contains the ground-pines or club-mosses and the selaginellas or little club-mosses, which are alike in producing their spores in the axils of leaves, but differ in the spore-characters. The club-mosses (*Lycopodium*) have yellow dust-like spores, which are used commercially under the name of lycopodium powder for the relief of chafing and for producing flash-lights, since they contain a large amount of oil and are highly inflammable. *Selaginella,* on the other hand, produces two kinds of spores — *microspores,* from which develop the male prothalli, and *macrospores,* from which develop the female prothalli. The lycopods are familiar as Christmas greens, but are rarely seen in cultivation. Over 100 species are known of which 17 are found within the limits of the United States. *Selaginella,* on the other hand, is frequent in cultivation, some of the species being exceedingly delicate and graceful; but most of our native species are inconspicuous and little known. The «resurrection-plant» has already been mentioned. Some of the tropical species attain enormous size as climbing-plants. Over 600 species have been described, of which 27 are found in the United States. A third family is represented in the Southern States by a leafy epiphyte (*Psilotum*). Two other small genera occur in Australia and neighboring islands.

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Feronia, fē-rō'nī-a̤, (1) An ancient Italian goddess, who presided over woods and orchards. The ancient grove, not far from Anxur (Terracina), was consecrated to her, and is very celebrated. Emancipated slaves received a cap in her temple as a badge of freedom. (2) A genus of beetles of the family *Carabidæ.* (3) A genus of plants allied to the orange.

Ferrand, Marie Louis, mä-rē loo-ē fĕ-räṅ, French soldier: b. Besançon, France, 12 Oct. 1753; d. Santo Domingo, 7 Nov. 1808. He served as a volunteer in the American Revolution, was imprisoned during the French Revolution as a friend of Lafayette, but was released and placed in command of a brigade in the armies of Ardennes and Sambre-et-Meuse. He went with General Leclerc to Santo Domingo 1801, succeeding Le Clerc as governor-general 1802. He was besieged by General Dessalines 1804, but withstood until the arrival of reinforcements under Admiral Missiessy, holding the eastern part of the island for several years, but, defeated at Paolo Fincado by Ramireshu, he shot himself on the battlefield.

Ferrara, fĕr-rä'rä, a province of Italy; on the north boundary is the Po River and on the east the Adriatic Sea; area, 1,144 square miles. The low ground is marshy, but good crops are raised on the uplands. The climate is unhealthful. Ferrara was once a duchy of Italy; it was held by the House of Este as a papal fief till 1597. It became a part of the States of the Church in 1598. In 1860 it was incorporated into the kingdom of Italy. Pop. 271,776.

Ferrara, Italy, city, capital of the province of Ferrara, 26 miles north-northeast Bologna, in a fertile but unhealthy plain, at a short distance from the north branch of the Po. It is a large and well-built town, with spacious and regular streets, and is enclosed by a wall seven miles in circuit. It is defended on the west side by a citadel regularly fortified. In the middle of the city is a castle, flanked with towers, and surrounded by wet ditches, which was once the residence of the dukes. Ferrara, though still retaining many traces of its former grandeur, has long been falling into decay; its pavements are overgrown with grass, and the staircases and balconies of many of its noble palaces are overrun with ivy, while others are without either doors or windows. The population has also fallen to one fourth of its former amount. It has a cathedral and numerous churches, most of which contain valuable paintings, together with some interesting specimens of sculpture. There are here a public gallery of paintings, called the Palazzo del Magistrato, containing many excellent works by the leading painters of the Ferrara school, of which Dosso

Dossi was one of the leaders. The city contains also a school of medicine and jurisprudence, and a public library containing about 100,000 volumes and 900 manuscripts, the latter including some of those of Ariosto and Tasso. The house in which Ariosto was educated, and that in which he lived during his latter years, and known by the names respectively of the Casa degli Ariosti and the Casa d'Ariosto, are shown to strangers. The latter is now national property, and is ranked among the national monuments. Another object of interest is the cell in the Hospital of St. Anna, in which Tasso was imprisoned. The house occupied by Guarini, the author of the Pastor Fido — the Casa Guarina — is still inhabited by the marquises of that name. Ferrara is an archbishopric; the bishopric dates from 661; its archbishopric was founded by Clement XII. in 1735. It carries on some trade in corn and other produce of the soil. There are manufactures of silk ribbons, wax candles, and brazen utensils; tanneries and glass works. Pop. of the commune about 90,000.

Ferrari, Gaudenzio, gâ-dĕn'dzē-ō fĕr-rä'rē, Italian painter: b. Valduggia, Piedmont, 1484; d. Milan 31 Jan. 1549. A scholar of Andrea Scotto, he also caught some inspiration from Da Vinci and Raphael. The chief characteristics of his style are correct and vigorous delineation, strong but often hard coloring, considerable power of invention, and skill in the arrangement of drapery. He executed innumerable paintings both in fresco and in oil, the greater part of which are possessed by the Lombard galleries. His most comprehensive work, the frescoes at Varallo, in Piedmont, represents the Passion; another good specimen of his work, the ‘Martyrdom of St. Catharine,’ is in the Brera Gallery at Milan. He died at Milan in 1549. The chief of his pupils was Andrea Solario. See Colombo, ‘Vita di Ferrari’ (1881).

Ferrari, Giuseppe, gwē-sep'pā fĕr-rä'rē, Italian philosopher and historian: b. Milan, Italy, 1812; d. Rome 1 July 1876. He wrote: ‘On Error’ (1840); ‘Campanella's Religious Opinions’ (1840); ‘Machiavelli as Judge of the Revolutions of Our Time’ (1849); ‘Philosophy of Revolutions’ (1851); ‘History of Italian Revolutions, or Guelphs and Ghibellines’ (1856–8); etc.

Ferrari, Paolo, Italian dramatist: b. Modena 5 April 1822; d. Milan 9 March 1889. He produced his first comedy, ‘Bartolommeo il Calzolajo,’ in 1847. Of his many later works, ‘Goldoni’ (1852), and ‘Parini e la Satira’ (1857) rank as the finest examples of modern Italian comedy, and are distinguished — as, indeed, are most of his plays — by a piquancy and sparkling dialogue, as well as cleverness of construction and occasional sharp contrasts, such as have been mostly identified with French comedy. A collection of his ‘Opere drammatiche’ was published at Milan in 14 volumes (1877–80). In 1860 he became professor of history at Modena, and afterward in the Academy at Milan.

Ferraris, Carlo Francesco, kar'-lō frän-chĕs'kō fĕr-rä'rēs, Italian political economist and statistician: b. Moncalvo, Alessandria, Italy, 15 Aug. 1850. In 1878 he was appointed professor extraordinary in the University of Pavia and in 1885 professor of statistics at Padua. Among his works are: ‘La Statistica e la Scienza delle Amministrazione nelle Facultà Giuridiche’ (1878); ‘Moneta e Corso Forzoso’ (1879); ‘Saggi di Economia Statistica e Scienze delle Amministrazione’ (1880); ‘La Statistica del Movimento dei Metalli Preziosi fra l'Italia e l'Estero’ (1883); ‘L'assicurazione obbligatoria e la risponsibilita dei Padroni, ed imprenditori' per gli sufortuni sul lavoro’ (1890); ‘Principii di scienza bancaria’ (1892).

Ferraris, Galileo, gä-lē-lä'ō fā-rä'rēs, Italian physicist and electrician: b. Livorno, Piedmont, 1847; d. 1897. He was graduated in civil engineering at the Royal School of Engineering’ (1869). On being appointed professor of physics in the Industrial Museum and in the Military College at Turin, he devoted himself to the study of technical physics and was in a short time recognized as one of the foremost electricians in Europe. In 1885 his investigations into the properties of various electrical transformers resulted in the discovery of the rotatory magnetic field, produced by two alternating currents with a quarter difference of phase. This discovery made possible the two-phase motor. In 1893 he published a theory of the single-phase alternating motor, and to him the present development of alternating currents must largely be credited. His works on such subjects are standard authorities, and among them must be mentioned: ‘On the Difference of Phase of Currents’; ‘On the Lag of Induction’; and ‘On the Waste of Energy in Transformers’ (1887).

Ferrate, fĕr'-āt, in chemistry, a salt made of ferric acid, a weak, unstable compound of iron and oxygen, with bases. See Iron.

Ferrazzi, Giuseppe Jacopo, yä'kō-pō gwē-sep'pā fĕr rät'sē, Italian author: b. Cartigliano, Italy, 20 March 1813; d. Bassano, Italy, 1881. He published: ‘Hand-books to Dante’ (1865–77); ‘Torquato Tasso: a Biographical, Critical, and Bibliographical Study’ (1880); and studies of Ariosto, besides an ‘Italian Anthology’ (1858–9).

Ferree, James Barr, American architect and art critic: b. Philadelphia, Pa. He was graduated from the University of Pennsylvania 1884. He is the president of the department of architecture in the Brooklyn Institute of Arts and Sciences; is a member of several American and foreign architectural societies, and has written many professional papers for leading architectural and other periodicals.

Ferreira, Antonio, äṅ-tō'nē-ō fĕr rä'î-rä, Portuguese poet: b. Lisbon, Portugal, 1528; d. 1569. He held a professorship at the University of Coimbra, and subsequently became judge of the supreme court at Lisbon. During his leisure he composed sonnets, odes, and epigrams, which earned for him the title of the «Portuguese Horace.» His high literary reputation, however, is due to his ‘Epistles’ and the tragedy of ‘Inez de Castro,’ the second regular tragedy produced in Europe. The subject is a popular Portuguese legend; and the play is modeled upon the Greek tragic drama.

Ferreira de Vasconcellos, Jorge, zhōr'zhā fĕr-rä'î rä dä vas''kon-sel'ösh, Portuguese dramatist: b. Coimbra or Montemor o Velho; d. 1585. His prose comedies, ‘Euphrosyne’ (1560); ‘Usilippo’ (1618); ‘Aulegraphia’

(1619), are strictly national, and are valuable both philologically and for the proverbs in which they abound. He wrote also a romance of chivalry, 'The Triumph of Sagramor' (1567).

Ferreiro, fĕr-rā'ĭ-rō, a Brazilian tree-frog (q.v.).

Fer'rel, William, American meteorologist: b. Bedford County, Pa., 1817; d. 1891. He was graduated at Bethany College, Virginia, in 1844, and early attracted attention by his researches in meteorology, of which science he was the first to propound the fundamental principles. From being an associate in the work of putting forth the 'Nautical Almanac' he was appointed to the United States Coast and Geodetic Survey. From 1882 to 1886 he was an assistant in the Signal Service Bureau, and the maxima and minima tide-predicting machine which he invented has been used for many years in government coast surveys. Among his writings are: 'Popular Treatise on the Winds, Monsoons, Cyclones, etc.' (1889); 'Tidal Action'; 'Meteorological Researches.'

Ferreras, Juan de, hoo än' dā fĕr-rā'ras, Spanish historian: b. Labañeza, Spain, 7 June 1652; d. 8 June 1735. He was a scholarly priest, whose careful 'History of Spain' (1700–27) is authoritative for the period prior to 1598; his 'Poems' (1726) are less important.

Fer'rers, fĕr'rĕrz, **Norman Macleod,** English mathematician: b. Gloucestershire 11 Aug. 1829. He was educated at Eton and Gonville and Caius College, Cambridge, of which latter institution he has been master from 1880. He has published: 'A Treatise on Trilinear Coordinates' (1861); 'A Treatise on Spherical Harmonics' (1877).

Fer'ret, a small and slender variety of polecat (q.v.), usually an albino, yellowish white, with pink eyes. It is bred chiefly as a domestic exterminator of mice and rats, and is used also in rabbit hunting. Unlike the ordinary polecat, it is exceedingly sensitive to cold, and must be well protected in northern climates which do not at all affect the polecat. Though bred in confinement, the ferret exhibits no affection, even for its master; and must be carefully secured, lest it escape and do injury. It has been known to hurt infants, and, if it gets at poultry, it will kill far more than it can eat. The female even, at times, devours her young. A cross between the ferret and the polecat is sometimes used.

Ferret, Col de, cōl de fĕ-rā, a pass of the Alps, in Switzerland, connecting Orsières, in the latter country, with Cormayeur, in Italy. Height 8,320 feet above sea-level. See ALPS.

Ferreting, the sport, well known in England, of chasing rabbits or hunting vermin (rats) with trained ferrets (q.v.). To pounce upon the victim and kill («pith») it by a single bite in the neck, is regarded as a mark of high excellence in a ferret by ferreters. The principal use of ferrets, however, is not to kill the prey, but to go into their burrows and hiding places, muzzled, and drive out the animals.

Ferri, Ciro, chē'rō fĕr'rē, Italian painter, architect, and engraver: b. Rome 1634; d. there 4 Sept. 1689. He was a pupil and imitator of Pietro da Cortona, but displays less grace and less richness of color than his master. His canvases are scattered through Italy. He completed the frescoes in Pitti Palace, begun by da Cortona, and among his other paintings are the ceiling of the Annunziata and the cupola of St. Agnese, Piazza Navona, Rome, unfinished; 'Repose in Egypt'; 'Alexander Reading Homer'; 'Death of Dido,' Dresden; 'Triumph of Bacchus,' London. Among his architectural pieces are the altars of Chiesa Nuova and other churches in Rome. He left a great number of etchings.

Ferri, Enrico, en rē'kō fĕr'rē, Italian sociologist: b. San Benedetta-Po, Mantua, 25 Feb. 1856. He was educated at Bologna, Pisa, and Paris, and was admitted to the bar. He practises law at Rome, having been a member of the Chamber of Deputies since 1886, representing a socialistic following. Among his works are: 'Sociologie Criminelle' (1893, English translation 1896); 'La Scuola positiva di dirrito criminale' (1883); 'Difese pmali e studi di giurisprudins a' (1898); 'Deliquenti nell' arte' (1901).

Ferri, Luigi, loo-ē'jē fĕr'rē, Italian philosopher: b. Bologna 1826; d. Rome 1895. He entered the normal school, Paris, 1847, teaching philosophy in Châlon, Evreux, Dieppe, Blois, and Toulouse 1850–5. Returning to Italy he became secretary of public instruction 1860, professor of philosophy and history at the Institute of Florence 1863, and at the University of Rome 1871. Among his works are: 'Il Genio d'Aristotele' (1866); 'Studii su Leonardo da Vinci' (1871); 'Il senso commune nella filosofia' (1872); 'Sulla dotrina psicologica dell' associazione' (1878); 'la Psicologia di Pietro Pomponazzi' (1877); and in French 'Essai sur l'histoire de la philosophie en Italie au XIXme siècle' (1869); and 'la Psychologie de l'Association depuis Hobbes jusqu'à nos jours' (1883).

Ferric Oxide, or **Sesquioxide of Iron.** See HEMATITE; IRON.

Ferricyanide of Potassium. See HYDROCYANIC ACID.

Ferrier, fĕr'ĭ-ĕr, **David,** Scottish neurologist: b. Woodside, near Aberdeen, 1843. In 1872 he became professor of forensic medicine in King's College, London, a chair which he exchanged in 1889 for that of neuro-pathology, specially founded for him. He has gained a wide reputation by his investigations of the structure of the brain, particularly in connection with the localization of its functions. His results are stated in his works on the 'Functions of the Brain' (1876); and 'Cerebral Localization' (1878). His researches necessitated a large number of experiments on living animals, and he has, in consequence, been strongly attacked by the anti-vivisectionists.

Ferrier, Joseph Marie Augustin Gabriel, zhō-zeph mä-rē ō-güs-tăn gä-bri-el, French painter: b. Nîmes, France, 29 Sept. 1847. He studied under Lecocque Boisbaudran. His work has been recognized as vigorous and elevated. He won the Grand Prix de Rome in 1872, and was decorated with the cross of the Legion of Honor in 1884. Among well-known works of his are: 'David Conqueror of Goliath,' in the Nîmes Museum, and 'Saint Agnes, Martyr,' in the museum at Rouen.

Ferrier, Susan Edmonstone, Scottish novelist: b. Edinburgh, Scotland, 7 Sept. 1782; d. there 5 Nov. 1854. She was an intimate friend of Sir Walter Scott and of some of the most eminent literati of her day. She wrote three novels: ‘Marriage’ (1818); ‘The Inheritance’ (1824); and ‘Destiny, or the Chief's Daughter’ (1831). They are vigorous and lively pictures of Scottish life and character, but exhibit a certain hardness and want of sympathy at times.

Ferris, Albert Warren, American physician: b. Brooklyn, N. Y., 1856. He was graduated at the New York University 1878, and at the Columbia University College of Physicians and Surgeons 1882. He became assistant in neurology, Columbia University, 1893, and assistant in medicine in the New York University medical department 1898. Appointed commissioner of lunacy, New York State, 1907.

Ferris, George Titus, American writer on music. His works include: ‘Great German Composers’ (1879); ‘Great Italian and French Composers’ (1879); ‘Great Singers’ (1880–1); ‘Great Violinists and Pianists’ (1881).

Ferris, George Washington Gale, American engineer: b. Galesburg, Ill., 14 Feb. 1859; d. Pittsburg, Pa., 22 Nov. 1896. He was graduated at Rensselaer Polytechnic Institute in 1881; went to Pittsburg, Pa., in 1892, while in the employ of the Louisville & Nashville Railroad, to inspect the structural work of the railroad bridge at Henderson, Ky. About this time he conceived the idea of a gigantic revolving wheel which he built in Pittsburg and erected for the World's Columbian Exposition in Chicago in 1893. The wheel could hold more than 1,000 passengers, and during the Exposition it was one of the great attractions.

Ferris, Isaac, American Dutch Reformed clergyman and educator: b. New York 9 Oct. 1798; d. Roselle, N. J., 1873. He was graduated at the Reformed Dutch Seminary, New Brunswick, N. J., 1820; was pastor at New Brunswick 1821–4; Albany 1824–6, and New York 1836–53. He was chancellor of the University of the City of New York 1852–70.

Ferris, Mary Lanman Douw, American author: b. Poughkeepsie, N. Y., 22 May 1855. She was married to M. P. Ferris (q.v.) 4 Sept. 1879. She is the founder of the Daughters of the Cincinnati, and was instrumental in establishing the museum in Van Cortlandt Park, New York, now maintained by the Colonial Dames. She is the editor of the ‘Bulletin of the Society of American Authors,’ and has published: ‘Dutch Nursery Rhymes of Colonial Times’; ‘Random Rhymes of Old Dutch Times’; ‘History of Fort Crails’; etc.

Ferris, Morris Patterson, American lawyer: b. New York 3 Oct. 1855. He is a son of I. Ferris (q.v.) and was graduated from the law department, University of New York, 1876. He is president of the Yonkers Historical and Library Association; secretary of the Sons of the Revolution; secretary of the Colonial War Lake George Monument Committee, secretary of the New York State Historical Association, registrar of the Society of the War of 1812, and treasurer of the Society of American Authors.

Ferro, fĕr′rō, or **Hierro,** yĕr′rō, the most westerly of the Canary Islands, and the smallest of those which are inhabited; longitude of the western extremity, 18° 9′. It is about 18 miles long and 9 miles broad. It is a rocky, volcanic island, rising to the height of over 4,100 feet, and has numerous extinct craters, and a number of warm springs. It is by no means fertile, but good wine and brandy are made, and excellent figs are grown on the island. This island was once considered the most western point of the Old World, and geographers reckoned longitude from it. For this purpose the longitude of Ferro was in France taken as exactly 20° west of that of Paris, though this meridian really passes some miles to the east of the island. German geographers adhered longest to the meridian of Ferro in constructing their maps. Pop. 5,980.

Ferrol, fĕr-rōl′, or **El Ferrol,** Spain, seaport in the province of La Coruña; about 12 miles northeast of the town of La Coruña; on the Bay of Betanzos, a few miles from the ocean. The bay forms one of the best natural harbors in Europe, and the narrow channel which leads to it is defended by the forts San Felipe and Palma. Charles III. built here an arsenal for the Spanish navy, which is still in use. The manufactures consist chiefly of swords, cutlery, and military and naval equipments, sail-cloth, and leather. The sardine fishery is also important. The principal imports are coal, iron, timber, cotton, and grain; the chief exports are fish, iron, and vinegar. Pop. about 26,000.

Ferrotype, or **Energiatype,** in photography, a process first made public by Robert Hunt in 1844, in which the negative was developed by a saturated solution of protosulphate of iron, with mucilage of gum-arabic, and fixed by soaking in water to which a small quantity of ammonia or hyposulphite of soda had been added. See PHOTOGRAPHY.

Ferrous Sulphate, Ferrous Compounds. See IRON.

Ferry, Gabriel, gă-brî-el fĕ-rē, the Elder (pseudonym of EUGÈNE LOUIS GABRIEL FERRY DE BELLEMARE, ü-zhen loo-ē gä-bri-el fĕ-rē de bel-mar), French author: b. Paris, France, 30 May 1809; d. 1852. His stories appeared first serially in the ‘Revue des Deux Mondes.’ He made repeated voyages to the United States; in his last voyage, to California, he lost his life in the burning at sea of the ship Amazon. Among his tales are: ‘The Woodranger’; ‘Hunting with Cossacks’; ‘Costal the Indian’; ‘Scenes of Military Life in Mexico’; ‘The Squatters.’

Ferry, Gabriel, the Younger, French author, dramatist, and novelist: b. Paris 30 May 1846. He is a son of Gabriel the Elder and employs the same pseudonym. He has written plays: ‘Réginah’ (1874), being one of the best; while his miscellaneous prose includes: ‘The Last Years of Alexandre Dumas, 1864–70’ (1883); ‘Balzac et ses amies’ (1888); ‘The Exploits of Cæsar: a Parisian Novel’ (1889).

Ferry, Jules François Camille, zhūl fräṅ-swä cä mēl fĕ-rē, French statesman: b. Saint Dié, France, 5 April 1832; d. Paris 17 March 1893. He was admitted to the Paris bar in 1854, and speedily identified himself with the opponents of the empire. His hostility was carried into journalism, and a series of articles in the ‘Temps’ (‘Times’), were republished as ‘The Fantastic Tales of Haussmann’ (1865). In 1869 he was elected to the National Assembly, where he voted against the war with Prussia; and during the siege of Paris by the Germans (1870–1) he played a prominent part as central mayor of the city. He was minister to Athens 1872–3, and in 1879 became minister of public instruction and began an agitation against the Jesuits. Their expulsion was effected, and brought about the dissolution of the ministry in September 1880. M. Ferry then formed a cabinet, which remained in office till November 1881. In February 1883 he again became premier, with a policy of «colonial expansion,» involving a war in Madagascar and the invasion of Tonquin, where a disaster to the French troops brought about his downfall in March 1885. In 1890 he was made senator. His ‹Discours et Opinions› appeared in 7 volumes (1893–8).

Ferry, Orris Sandford, American statesman and soldier: b. Bethel, Conn., 1823; d. 1875. He was graduated at Yale in 1844. After filling important political places in his native State he was in 1859 elected to Congress as a Republican, and sat as one of the famous Committee of Thirty-Three appointed to consider and report upon the condition and relations of the seceded States. He was colonel of the Fifth Connecticut Volunteer Infantry (1861), and served from 1862 to the end of the war as brigadier-general of volunteers. He was elected to the United States Senate as a Republican in 1866, and re-elected in 1872.

Ferry, Thomas White, American politician: b. Mackinac, Mich., 1 June 1827; d. Grand Haven, Mich., 14 Oct. 1896. He served in the State legislature and from 1865 to 1871 was a Republican member of Congress. He was elected to the United States Senate; and on the death of Henry Wilson was acting Vice-President of the United States from 1875 to 1877.

Fersen, fĕr'sen, **Hans Axel,** COUNT VON, Swedish military officer: b. Stockholm, Sweden, 1755; d. there 20 June 1810. He came to America on the staff of Rochambeau; fought under Lafayette and received from Washington the Order of the Society of the Cincinnati. Later he went to France, where he became a favorite at court, and was the disguised coachman at the flight of the royal family from Versailles during the Revolution. He returned to Sweden, where he was received with honor, and in 1801 was made grand marshal of that country. On suspicion of complicity in the death of Prince Christian of Sweden, he was seized by a mob while marshaling the funeral procession, and tortured to death.

Fertilization of the Ovum. See EMBRYOLOGY.

Fertilizers. Any substance applied to the soil to aid the growth of plants may properly be called a fertilizer. The name has, however, become associated with a class of materials manufactured and sold for this purpose, the handling of which now constitutes an important industry.

The constituents of the plant that it derives from the soil are nitrogen, phosphorus, sulphur, potassium, sodium, calcium, magnesium, iron, aluminum, manganese, silicon, chlorine. Of these, nitrogen, phosphorus or phosphoric acid, and potassium or potash, are the substances most likely to be deficient in the soil, and therefore the ones that are contained in fertilizers. A fertilizer may contain any one or more of these substances.

The chief distinction between the functions of farm manure and commercial fertilizers may be stated in a general way to be that farm manure increases crop production by improving the condition of the soil, while the commercial fertilizers act directly as a plant-food without materially affecting soil structure.

It is evident, therefore, that commercial fertilizers are not an adequate substitute for farm manure or green manures for producing permanent improvement. Their function consists in supplementing the available supply of plant-food in a soil which may be deficient in any one or more of the substances usually contained in fertilizers. On virgin soils commercial fertilizers are generally superfluous; but as loss of plant-food goes on under cropping, restitution must be made and, as this is usually not adequately done with farm manure, fertilizers are finally called upon.

In regions where there is large loss of plant-food from the soil due to leaching, there must be a large excess of potential fertility in order that the growing crop shall at all times be supplied with available plant-food. A deficiency in any constituent will check growth by compelling the plant to depend upon a less readily available supply. Commercial fertilizers are useful by presenting readily available food to the plant when it is beginning growth, and when a deficiency in the supply is likely to produce a permanent injury.

As the price of land increases, as the cost of labor becomes greater, and as the value of the crop augments it becomes more important that maximum crops shall be raised, and for these reasons commercial fertilizers have greatest sale where agriculture is most intensive. There are also many special crops requiring more of one plant-food than of another, and the needs of these can best be met by the use of commercial fertilizers.

Historical.— The value of animal excrements applied to soils on which crops were grown has been appreciated by the husbandman as far back as records go. Why this manure is beneficial, and what relation its constituents bear to those of plants, are matters which have only been worked out during the last century, and knowledge of which has led to the use of fertilizers composed of mineral salts, commonly known as commercial fertilizers.

The earliest record of the use of mineral salts for increasing the yield of crops is contained in a book entitled ‹A Discourse Concerning the Vegetation of Plants.› The title page also contains the following announcements: «Spoken by Sir Kenelm Digby, at Gresham College, on the 23d of January 1660. (At a meeting of the Society for Promoting Philosophical Knowledge by Experiments. London. Printed for John Williams, in Little Britain, over against St. Botolph's Church, 1669.)» The author advocates the use of saltpetre to increase the yield of crops, and says: «By the help of plain saltpetre, dilated in water and mingled with some other fit earthy substance, that may familiarize it a little with the corn into which I endeavored to introduce it, I have made the barrenest ground far out-go the richest, in giving a prodigiously plentiful harvest.» His dissertation does not, however, show any true conception of the reason for the increase in the crop through the use of this fertilizer. The almost total absence of any knowledge of the composition of plants, and the crude state of chemistry at that time, made this quite impossible.

It was not until 1804 that any light was thrown upon the subject. In that year was published 'Recherches Chimique sur la Végétation,' by Theodore de Saussure. This brilliant French investigator was the first to appreciate the significance of the ash ingredients of plants; to point out that without them plant life was impossible, and to show that only the ash of the plant was derived from the soil.

Justus von Liebig is commonly regarded as having laid the foundation upon which the commercial fertilizer industry has been built. Certainly his reports to the British Association in 1840 and again in 1842 made the British agriculturists regard as they had never done before the importance of a sufficient supply of certain readily soluble mineral substances in the soil. He supported the contention of De Saussure regarding the importance of mineral matter in the plant, and its extractions from the soil. He refuted the theory, at that time popular, that plants absorbed their carbon from humus, but made the mistake of attaching little importance to the presence of humus in the soil. He showed the importance of potash and phosphates in manures, and in his earlier writings spoke of the value of nitrogen for fertilizing crops, but afterward made the mistake of denying the usefulness of nitrogenous manures for plants, holding that the ammonia washed down by rain affords a sufficient supply.

By the middle of the 19th century it was well understood that potash, phosphoric acid, and nitrogen were valuable constituents of fertilizers, and that the other mineral elements of plant-food, with the occasional exception of calcium, were always present in sufficient quantity in arable soils. It has since been shown that the family of plants known as the *Leguminosæ* have the ability to secure a large part, at least, of their nitrogen from the air, and that as these plants are very rich in nitrogen they leave a supply of nitrogen in organic matter in the soil when plowed under, or even when the roots alone are allowed to remain in the soil.

Direct and Indirect Fertilizers.— Fertilizers that add to the soil only mineral constituents that are taken up by plants may be called direct manures. However, soil amendments are sometimes used which contain in addition to or in place of these substances certain constituents that increase the crop without adding to the supply of the fertilizing constituents. These may be called indirect fertilizers. Farmyard manure is an example of this, as in addition to the mineral constituents of the plant it adds a quantity of purely organic matter which, through its decomposition, exerts a very beneficial effect upon crop-production.

Complete and Incomplete Fertilizers.— Fertilizers, containing nitrogen, phosphoric acid, and potash, mixed together so that an application of the preparation will result in bringing each of these substances in contact with the soil wherever applied, are called complete fertilizers. The proportions in which the constituents are mixed vary with the different brands and factories. Sometimes a fertilizer of this kind will be advertised for use on a certain crop, and will contain the nitrogen, phosphoric acid, and potash in the proportion in which the manufacturer believes they will produce the best yields of that crop. He has, however, no means of knowing the requirements of the soils on which the fertilizer is to be used.

Incomplete fertilizers contain only one or two of the customary fertilizer ingredients.

Available and Unavailable Fertilizing Material.— The fertilizing constituents in a fertilizer may be present in a readily soluble or a difficultly soluble condition, depending upon the chemical combinations and, to some extent, upon the physical condition in which they are found. Thus phosphoric acid when in the form of phosphate rock as it is taken from the deposits is a very difficultly soluble substance, and plants can avail themselves of it only in small quantities. After the same rock has been treated with sulphuric acid the phosphoric acid is in a form in which it can be readily used by plants. To a more limited extent the same is true of the phosphoric acid in basic slag, which, when the slag is in an unground condition, is not of much use to plants, but when the slag has been finely ground furnishes a valuable form of plant-food.

When the fertilizing material is in a condition in which it can be readily used by the plant it is said to be «available,» and when it can be used only with great difficulty it is said to be «unavailable.» It is important that the purchaser should know in what form the constituents are present in a fertilizer.

Nitrogenous Fertilizers.— Nitrogen is taken up by most plants only in the form of a soluble salt; hence for the cereals and many other crops it is desirable either to have it in this form or to incorporate it in the soil in a condition in which it will readily be converted into a soluble salt. Plants like the clovers, alfalfa, peas, beans, etc., have the power of using the nitrogen of the air, and hence do not require nitrogenous fertilizers in such large amounts. These plants may be used to increase the supply of nitrogen in the soil. Nitrogen is the most expensive constituent of fertilizers, and is extremely important, as it is used in large amounts by plants and is likely to be deficient in soils. The form in which nitrogen is present in a fertilizer may make a great difference in its value and in the way in which it can be best applied. Nitrogenous fertilizers differ in having their nitrogen either in the form of a soluble salt or combined as organic material. Nitrate of soda and sulphate of ammonia are the forms in which soluble nitrogen salts are found on the market.

Ammonium Sulphate.— When coal is distilled a portion of the nitrogen is liberated as ammonia, and is found in the ammoniacal liquor which condenses when the products of distillation are cooled. Coal is distilled for the production of coal-gas for illuminating purposes, and also in the manufacture of coke. Gas-works and coke-oven thus provide a large share of ammoniacal liquor, which forms the raw material for the manufacture of ammonium salts. Another source of ammonia is the liquid condensed from the «water-gas» formed when a current of steam is forced over red-hot coal. The product obtained in any of these processes is a mixture of ammonium sulphide, carbonate, thiosulphate, thiocyanate, and chloride, dissolved in water.

To prepare this for use the liquid is heated and lime is added. The ammonia volatilizes partly as carbonate and sulphide, and partly as free ammonia, and is received in sulphuric acid, forming ammonium sulphate and driving off as gases carbon dioxide and sulphuretted hydrogen. The liquid is then evaporated in leaden pans until it crystallizes.

The world's output of ammonium sulphate in 1900 is placed at 493,000 tons, of which 270,000 tons were used as fertilizer.

Chemically pure sulphate of ammonia contains 21.2 per cent of nitrogen. The commercial product contains about 20 per cent of nitrogen. It is the most concentrated form in which nitrogen can be purchased for use as a fertilizer.

Nitrate of Soda.— This fertilizer now constitutes the principal source of nitrogen in artificial manures, having largely taken the place of Peruvian guano, which was extensively used for many years, and the profitable use of which did much to promote the extensive use of commercial fertilizers. The salt occurs in the crude condition called caliche, in enormous deposits, principally in the province of Tarapaca in northern Chile. The earlier records of these deposits extend back to 1820, but it was not until several years later that they were exploited. The portion of the country in which the deposits lie is a sandy desert where rain never falls. The altitude is 3,000 to 4,000 feet above the sea-level. The deposits are attributed to the action of minute organisms fixing in the soil, through countless ages, the nitrogen of the atmosphere, and leaving the product finally in the form of sodium nitrate that has crystallized out of solution in which it has at some time been held.

The raw product is found beneath a covering consisting of two layers, the upper one of sand and gypsum and the lower of baked clay and gravel. The thickness of the caliche varies from a few inches to 12 feet. It is extracted by boring through the upper layers and introducing a charge of blasting-powder, which, when fired, exposes a considerable quantity of the material. The nitrate is somewhat purified by crystallization before shipping. Iodine is a by-product in the purification process. The nitrate, when ready for shipment, contains about 96 per cent sodium nitrate, or about 16 per cent of nitrogen, 2 per cent of water, and small amounts of sodium chloride, sulphates, and insoluble matter.

The development of the nitrate industry may be appreciated from the fact that the product, which amounted in 1884 to 550,000 tons, increased to 1,000,000 tons in 1890, and to 1,475,000 tons in 1900. The output is exported almost entirely to Europe and the United States. It is held by many persons who have examined these deposits that at the present rate of mining they will be exhausted by the year 1930, in which case a serious deficiency in fertilizer nitrogen will occur, unless a new supply shall meanwhile have been discovered.

Other Nitrogenous Fertilizers.— A method for preparing what promises to be a valuable nitrogenous fertilizer has lately been worked out by a German chemist. The chief point of interest in this fertilizer lies in the fact that the nitrogen it contains is derived from the air, thus making use of an inexhaustible supply of that material. No artificial method for the fixation of atmospheric nitrogen has up to the present time been sufficiently inexpensive to make it a commercial success. The method referred to consists in heating lime and coal in an electric furnace and passing nitrogen gas over them. The product, calcium cyanamide, was tested in pots of soil and in field-tests at the Darmstadt and Posen experiment stations, and found to decompose in the soil with the formation of ammonia and nitric acid, and to furnish plants with nitrogen.

Attempts have been made, especially in recent years, to produce nitrate fertilizers by combining by electrical means the nitrogen and oxygen of the air, but these have so far not been reduced to a practical basis. Experiments with this end in view are now in progress at Niagara Falls.

Organic nitrogenous fertilizers include cotton-seed meal (7 per cent nitrogen when free from hulls), linseed meal (5.5 per cent nitrogen), castor-pomace (6 per cent nitrogen), and a number of refuse products from packing-houses, consisting of red-dried blood (13 per cent nitrogen), black-dried blood (6 to 12 per cent nitrogen), dried meal (13 per cent nitrogen), hoof-meal (12 per cent nitrogen), ground fish (8 per cent nitrogen), and tankage (concentrated 10 to 12 per cent, crushed, 4 to 9 per cent nitrogen), also leather-meal, and wool- and hair-waste, which last two on account of their physical condition are of little value.

There is an evident advantage in the use of the soluble salts where quick action is desired. The nitrogen of sodium nitrate is in a form in which it may be utilized directly by the plant, while ammonium salts, owing to their rapid oxidation in the soil, are almost as available. The nitrate should be applied to the soil only when the crop is planted or is ready to use it, otherwise it is likely to leach out of the soil. Nitrogen in the form of organic matter must undergo chemical changes in the soil before it can be utilized by the plant, and hence such fertilizers should be applied to the soil some time previous to their use by the crop.

As regards the relative value of the nitrogenous fertilizers, an exact rating is difficult to attain, but a summary of the various tests indicates that when nitrate is rated at 100 per cent, ammonium sulphate may be taken as the same; blood and cotton-seed meal, 70 per cent; dried and ground fish and hoof-meal, 65 per cent; bone and tankage, 60 per cent; and leather, ground horn, and wool-waste range from 2 per cent to 30 per cent.

Phosphate Fertilizers.— By the term phosphate fertilizers is meant those substances that are used for manures chiefly because of the phosphorus they contain. The phosphorus is generally present in the form of a phosphate of lime, iron, and alumina mixed with other substances. Some of these phosphates also contain organic matter, in which case they generally carry some nitrogen, which adds something to their value as fertilizers. Phosphates associated with organic matter decompose more quickly in the soil than purely mineral phosphates, and are therefore more readily available fertilizers.

Bone-Phosphate.— The bones of animals have been for a great many years an important form of phosphate manure. Formerly bones were used entirely in the raw condition, either ground or unground. In the ground condition they are a more quickly acting fertilizer. Raw bones contain about 22 per cent phosphoric acid and 4 per cent nitrogen. The phosphoric acid is in the form of tricalcium phosphate.

At the present time most of the bone used as manure is first boiled or steamed. This frees it from fat and nitrogenous matter, both of which are used in other ways. Steamed bone is a more valuable fertilizer than raw bone, as the fat in the latter retards decomposition, and also because the steamed bone is in a better mechanical condition. The form of the phosphoric acid is the same as in the raw bone, and varies from 28 to 30 per cent, while the nitrogen is reduced to about 1½ per cent. Bone tankage, which has already been spoken of as a nitrogen fertilizer, contains from 7 per cent to 9 per cent phosphoric acid, largely in the form of tricalcium phosphate. All of these bone-phosphates are slow-acting fertilizers, and should be used finely ground, and for the permanent benefit of the soil rather than as direct plant-food.

Mineral Phosphates.— There are many natural deposits of mineral phosphates scattered over the earth, some of the most important of which are in America. The phosphorus in all of these is in the form of tricalcium phosphate, but the materials associated with it vary greatly.

Coprolites are concretionary nodules found in the chalk or other deposits in the south of England and in France, the name having been given them on the assumption that they consisted of fossilized animal excrement. They contain 25 to 30 per cent of phosphoric acid, the other constituents being calcium carbonate and silica.

Apatite is found in large quantities in the provinces of Quebec and Ontario, Canada. It occurs chiefly in crystalline form. The calcium phosphate of which it is composed is in one form associated with calcium fluoride, and in the other with calcium chloride. The Canadian apatite contains about 40 per cent phosphoric acid, being richer in this ingredient than that found elsewhere. Phosphorite is another name for apatite, but is chiefly applied to the impure amorphous form.

South Carolina phosphate has been mined since 1868. It occurs in the form of lumps from the size of a pebble to a mass weighing a ton. These are distributed through a deposit varying from 1 to 20 feet in thickness, which occurs both on the land and in the river beds. It contains from 26 to 28 per cent of phosphoric acid, and but a very small amount of iron and aluminum. As these substances interfere with the manufacture of superphosphates from the rock, their presence is very undesirable, rock containing more than 3 to 6 per cent being unsuitable.

Florida phosphates have been on the market since 1888. They occur in the forms of soft phosphate, a whitish product somewhat resembling clay, and largely contaminated with it; pebble phosphate, consisting of hard pebbles; rock or boulder phosphate, consisting as the name implies of rocks or boulders. Soft phosphate contains from 18 to 30 per cent of phosphoric acid, and on account of its being more easily ground than most of these rocks is applied to the land without being first converted into a superphosphate. Pebble rock constitutes the major portion of the Florida phosphate. It contains from 20 to 40 per cent of phosphoric acid, being very variable in composition. Rock or boulder phosphate is much more uniform in composition than the other kinds, but there is less of it. It contains about 40 per cent of phosphoric acid.

Tennessee phosphate was discovered in 1894. It differs from the Carolina and Florida phosphate in that it does not exist as nodules, pebbles, or boulders, but in veins and pockets, and does not need to be washed previous to its treatment. It contains from 30 to 35 per cent of phosphoric acid.

Basic slag, or, as it is also called, phosphate slag, or Thomas phosphate, is a by-product in the manufacture of steel from pig-iron rich in phosphorus. The phosphoric acid present is in the form of tetracalcium phosphate, $(CaO)_4P_2O_5$. It also contains calcium, magnesium, aluminum, iron, manganese, silica, and sulphur. On account of the presence of iron and aluminum, and because its phosphoric acid is more readily soluble than the tricalcium phosphate, the ground slag is applied directly to the soil without treatment with acid. It is produced in large quantities in England, Germany, and France. So successful has it proved as a fertilizer that a product known as "artificial Thomas phosphate" has lately been made in Germany.

Superphosphate Fertilizers.— In order to render more readily available to plants the phosphoric acid contained in bone and mineral phosphates, the raw material, purified by being washed and finely ground, is treated with sulphuric acid. This results in a replacement of phosphoric acid by sulphuric acid with the formation of monocalcium phosphate and calcium sulphate, with a smaller amount of dicalcium phosphate, according to the reactions:

$Ca_3(PO_4)_2 + 2H_2SO_4 = CaH_4(PO_4)_2 + 2CaSO_4$, and $Ca_3(PO_4)_2 + H_2SO_4 = Ca_2H_2(PO_4)_2 + CaSO_4$.

The tricalcium phosphate, being in excess of the sulphuric acid used, a part of it remains unchanged.

In the treatment of phosphate rock part of the sulphuric acid is consumed in acting upon the impurities present, which usually consist of calcium and magnesium carbonates, iron and aluminum phosphates, and calcium chloride or fluoride, converting the bases into sulphates, and freeing carbon dioxide, water, hydrochloric acid and hydrofluoric acid. The resulting superphosphate is therefore a mixture of monocalcium phosphate, dicalcium phosphate, tricalcium phosphate, calcium sulphate, and iron and aluminum sulphates.

In the superphosphates made from bone the iron and aluminum sulphates do not exist in any considerable amounts. However, as long as the phosphoric acid remains in the form of monocalcium phosphate the value of a pound of available phosphoric acid in the two kinds of fertilizer is the same, but the remaining tricalcium phosphate in the bone superphosphates has a greater value as before explained.

The superphosphates made from animal bone contain about 12 per cent available phosphoric acid and three or four per cent of insoluble phosphoric acid. They also contain some nitrogen. Bone-ash and bone-black superphosphates contain practically all of their phosphoric acid in an available form, but they contain little or no nitrogen. South Carolina rock superphosphate contains from 12 to 14 per cent available phosphoric acid, including from 1 to 3 per cent reverted phosphoric acid. The best Florida rock superphosphates contain from 17 per cent downward of available phosphoric acid, part of which is reverted. The Tennessee superphosphates vary from 14 to 18 per cent available phosphoric acid.

Reverted Phosphoric Acid.— On standing, a change sometimes occurs in superphosphates by which a part of the phosphoric acid becomes less easily soluble, and to that extent the value of the fertilizer is decreased. This change, known as «reversion,» is much more likely to occur in superphosphates made from rock than in those derived from bone. It will also vary in different samples, a well-made article usually undergoing little change even after long standing. It is supposed to be caused by the presence of undecomposed tricalcium phosphate, and of iron and aluminum sulphates.

The decrease in solubility of the superphosphate is due to the interaction of monocalcium phosphate and tricalcium phosphate leading to the formation of dicalcium phosphate, and perhaps to the formation of ferric and aluminum phosphates by the action of monocalcium phosphate upon the iron and aluminum sulphates.

Double Superphosphates.— In making superphosphates, a material rich in phosphoric acid must be used, not less than 60 per cent tricalcium phosphate being necessary for their profitable production. The poorer materials are sometimes used in making what are known as double superphosphates. For this purpose they are treated with an excess of dilute sulphuric acid; the dissolved phosphoric acid and the excess of sulphuric acid are separated from the mass by filtering, and are then used for treating phosphates, rich in calcium phosphate, forming superphosphates. The superphosphates so formed contain more than twice as much available phosphoric acid as those made in the ordinary way.

Relative Availability of Superphosphates.— Superphosphates and double superphosphates contain their phosphoric acid in a form in which it can be taken up by the plant at once. They are therefore best applied at a time when the crop is planted, or just before, or they may be applied when the crop is growing. In this respect their use differs radically from that of crude phosphates. Well-made superphosphates contain no free acids, and therefore are not injurious to vegetation unless used in excess.

Reverted phosphoric acid, although not soluble in water, is readily soluble in dilute acids. Its value as a ready source of food for plants has been the subject of much discussion among agricultural chemists. It is now quite generally believed that it furnishes an available supply of phosphoric acid to the plant. The American Association of Official Agricultural Chemists recognized this by adopting a statement of analysis which includes this form in the «total available phosphoric acid.»

Potash Fertilizers.— The production of potash fertilizers is largely confined to Germany, where are inexhaustible beds varying from 50 to 150 feet in thickness lying under a region of country extending from the Harz Mountains to the Elbe River, and known as the Stassfurt deposits. These deposits of potash salts have been mined since 1862, during which time they have constituted the world's principal supply of potash. They are operated by a syndicate comprising all the large owners, and maintaining a uniform price on the output.

Deposits have more lately been discovered in Thuringia, Brunswick, and Mecklenburg. The principal salts placed on the market are sylvine (potassium chloride); sylvinite, a mixture of sylvine, rock-salt, and kainite; carnallite (magnesium chloride and potassium chloride); schoenite (magnesium sulphate and potassium sulphate); kieserite (magnesium sulphate with carnallite); kainite (magnesium sulphate and potassium chloride, or magnesium and potassium sulphates and magnesium chloride); polyhalite (potassium, calcium, and magnesium sulphates).

In 1898 there were 1,330,505 tons of these salts produced, of which 1,056,226 tons were kainite, which is therefore the principal fertilizer produced.

The potash fertilizers contain their potassium either as chloride or sulphate. The chloride has the advantage of being more diffusible in the soil; but in most respects the sulphate is preferable. Potassium chloride has an injurious effect upon such crops as tobacco, sugar-beets, and potatoes. In tobacco the potassium chloride in the ash prevents the proper burning of the tobacco. In the case of clover, corn and grass, however, potassium chloride appears to have no harmful effects.

Kainite.— The potash contained in kainite is in the form of sulphate, but because of the large quantities of other salts it contains, chiefly sodium and magnesium chloride, it has the same effect upon plants as has the chloride. It contains from 12 to 20 per cent of potash, and 25 to 45 per cent of sodium chloride, with some chloride and sulphate of magnesium. Kainite should be applied to the soil a considerable time before the crop which it is intended to benefit is planted. It should not be drilled in with the seed. By this method of application the injurious properties of the chlorides will not affect the crop. Indirectly kainite serves to supply the plant with food other than potash. The salts associated with the potash, particularly the chlorides, aid plant-growth by making other substances in the soil, particularly phosphoric acid, more available to the plant, besides improving the physical condition of the soil.

Sylvinite.— This salt contains its potash both as chloride and as sulphate. It also contains sodium and magnesium chlorides. It contains about 16 per cent potash. Owing to the presence of chlorides it has the same effect as kainite.

Muriate (chloride) of Potash.— This is a more concentrated form of potash than either of those just mentioned. It contains about 50 per cent of potash, making it 80 per cent pure potassium chloride. The impurities are largely sodium chloride and insoluble mineral matter. A purer form of muriate of potash may be obtained which contains 98 per cent pure potassium chloride.

Sulphate of Potash.— High-grade sulphate of potash contains from 49 to 51 per cent of potash. Its advantage over muriate is that it is not, like the latter, injurious to any crops; but it has the disadvantage of being more expensive, and it has not, as has the chloride, indirect plant-feeding properties.

Schoenite.— This is a double sulphate of potash and magnesium. It contains about 26 per cent of potash. The cost of the potash is greater than in the muriate. The sulphate of magnesium it contains is supposed to have a beneficial effect upon the soil.

Other Fertilizing Materials.— There are a number of fertilizers not included in the classes already mentioned. Many of them are very valuable sources of fertility.

Wood-Ashes.— For some time after the use of fertilizers became an important farm practice, wood-ashes constituted a large portion of the supply of potash. They also contain considerable quantity of lime and a small amount of phosphoric acid. The product known as unleached wood-ashes contains 5 to 6 per cent of potash, 2 per cent of phosphoric acid, and 30 per cent of lime. Leached wood-ashes contain about 1 per cent of potash, 1.5 per cent of phosphoric acid, and 28 to 29 per cent of lime. They contain the potash in a readily available form as potassium carbonate. The lime conduces to a good physical condition of the soil.

Guano.— This fertilizer has been formed from the excrement and carcasses of sea-fowl. The composition of guano depends upon the climate of the region in which it is found. Guano from an arid region contains nitrogen, phosphoric acid, and sometimes potash, while that from a region where rains occur contains only phosphoric acid, the nitrogen and potash having been leached out. In a dry guano the nitrogen occurs as uric acid, urates, and in small quantities ammonium salts. A damp guano contains more ammonia. The phosphoric acid is present as calcium phosphate, ammonium phosphate, and as phosphates of other alkalies. A portion of the phosphate is readily soluble in water. All of the plant-food is thus either directly available or becomes so soon after admixture with the soil. The composition is extremely variable. Guano was formerly a very important fertilizing material, but the supply has become so nearly exhausted that it is relatively unimportant at the present time. South America, South Africa, Australia, and certain islands in the Pacific contribute to the supply.

Other fertilizers of less value are powder-waste, agricultural salt, cotton-hull ashes, coal-ashes, seaweed, king-crab, mussel and lobster shells, muck, peat, marl, tobacco stems and stalks, crude fish-scrap, wool- and hair-waste, sewage, street-sweepings, etc.

Lime.— The use of lime, either in the form of quicklime (CaO), air-slacked lime ($CaCO_3$), or gypsum ($CaSO_4$, $2H_2O$), also called "land-plaster," benefits greatly the physical condition of some soils, particularly those of heavy clay structure. Besides operating on the physical condition of the soil, it adds calcium and liberates a certain amount of plant-food held by the soil. Soils that contain free acid are greatly benefited by the application of caustic lime. Another function of lime in any of these forms is that of promoting nitrification.

Home Mixing of Fertilizers.— Fertilizers are ordinarily sold as (1) complete fertilizers containing nitrogen, phosphoric acid, and potash, which in different mixtures are to be found in different relative amounts; and (2) incomplete fertilizers, or raw material containing only one of these ingredients. Authorities at a number of the experiment stations have urged that it is in many cases more profitable for the farmer to purchase the incomplete fertilizers and mix them himself. The arguments advanced in favor of this practice are that the materials can be purchased more cheaply in that form than when mixed by the manufacturer; that they can be used in the proportion desired, which may effect a saving in the amount of some ingredient, and and that the form in which each ingredient is present is then known, which is not always the case when mixtures are purchased.

On the other hand, it is more difficult to obtain the raw materials from the small dealer, and when purchased they are not generally so finely ground as they are in the mixtures; and this in the case of the more difficultly soluble materials is a marked disadvantage.

State Control of Fertilizer Sales.— In most States in which fertilizers are largely used laws are in effect compelling manufacturers or dealers in fertilizers to state the actual amounts of the fertilizing ingredients contained in the fertilizers offered for sale, and also to state in what form each of these ingredients exists. A chemical control is provided and a penalty imposed for any failure to comply with the law. The control authorities publish each year a statement of the commercial value per pound of nitrogen, phosphoric acid, and potash in each of the various forms in which they occur in fertilizers. Fertilizer control is in most States attached to the State agricultural experiment stations, and information concerning the purchase and use of fertilizers can be obtained from these institutions.

Statistical.— The amount of fertilizers manufactured and consumed is increasing in all portions of the crop-producing world; and especially in the United States is there a rapid increase from one decade to another. In 1859 the value of the entire output of the fertilizer factories was $891,344; in 1869, $5,815,118; in 1879, $23,650,795; in 1889, $39,180,844; and in 1905, $56,632,853. Not all of this is used on farms in this country, there being $8,700,640 worth exported in 1910; but, nearly offsetting this, there was $8,371,883 worth imported. The imported fertilizers consisted largely of nitrate of soda, and potash salts, while the exported fertilizers were animal refuse and phosphate fertilizers. Of the total expenditure for fertilizers in 1899 70 per cent was consumed in the North Atlantic and South Atlantic States lying within 300 miles of the Atlantic seaboard. Nearly one half of the remainder was purchased in four States, Ohio, Indiana, Alabama, and Louisiana.

As is naturally to be expected, the first settled and longest cultivated portion of the country is that using the greatest quantity of fertilizers. This region lies nearest to the large centres of population and hence of consumption; it produces crops of greatest acre value; and it is so situated that the distances which it is necessary to transport fertilizers are generally less than they would be for the non-fertilizer-using portion of the country. It is true in the United States, as it is in Europe, that a large consumption of fertilizers goes hand in hand with a highly developed and intensive system of agriculture.

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Prof. of Agriculture, University of Nebraska.

Fesch, Joseph, zhō-zef fesh, French ecclesiastic: b. Ajaccio, Corsica, 3 Jan. 1763; d. Rome 3 May 1839. He was half brother to the mother of Napoleon. After Bonaparte in 1801 concluded the concordat with Pius VII, he became in 1802 archbishop of Lyons, and next year a cardinal. He was likewise appointed French ambassador at Rome, and made himself very acceptable to the Pope by his ultramontane tendencies. On the approach of the Austrians in 1814 he fled with his sister, Madame Bonaparte, to Rome, but Napoleon's return brought him back to France, and he acted as a peer during the Hundred Days. When called upon by the Bourbons to resign his episcopal rights he decidedly refused, but in 1825, after a papal brief interdicted him from exercising spiritual jurisdiction, he renounced the office, but retained the dignity.

Fes'cue, the popular name of a genus of grasses (*Festuca*), numbering upward of 80 species. The genus is of wide geographical distribution, but particularly numerous in the temperate regions, where they are among the most important of the pasture and fodder grasses. About 25 species are found in North America, many of them naturalized from Europe. The red fescue (*Festuca rubra*) serves to bind loose soil, and is also a good hay grass. The tall meadow fescue (*F. elatior*, var. *partensis*) is a fibrous-rooted perennial, growing from two to three feet high in low meadows and pastures, where it forms fresh herbage among the earliest of the cultivated grasses. The sheep's fescue (*F. ovina*) is much smaller. Sheep's fescue exists in many varieties in the northwestern States, especially in the Rocky Mountain region. Some of the varieties attain the height of two or three feet, but for the most part they are rarely more than a foot high, producing a large amount of fine herbage, which is valuable for grazing, especially for sheep. Some of the native varieties are well worthy the attention of the agriculturist. All the forms of *F. ovina* are «bunch-grasses,» and are devoid of the creeping roots, the presence of which distinguishes the red fescue (*F. rubra*) from this species. Sheep's fescue is well adapted for cultivation on light, dry soils, especially those which are shallow and silicious. A tall species is the giant fescue (*F. gigantea*), which occurs in shady woods and similar situations, from Maine to New York, adventive from Europe.

Fes'senden, Reginald Aubrey, American electrician: b. Bolton, Quebec, Canada, 6 Oct. 1866. He was chemist-in-chief in Thomas Edison's laboratory from 1887 to 1890 and the two following years an electrician with the Westinghouse Company of Newark, N. J. He was elected professor of electrical engineering in the Western University of Pennsylvania in 1893. He is the author of many inventions in electrical and chemical engineering and has written numerous scientific papers.

Fessenden, Thomas Green, American author: b. Walpole, N. H., 22 April 1771; d. Boston 11 Nov. 1837. He was graduated from Dartmouth College in 1796. He went to London in 1801, and while there published anonymously a satirical poem, ‹Terrible Tractoration› (1803). He returned to the United States; did literary work in New York; went to Boston and founded the ‹New England Farmer› (1822). Some of his publications were: ‹The American Clerk's Companion› (1815); ‹The Ladies' Monitor› (1818); and ‹Laws of Patents for New Inventions› (1822).

Fessenden, William Pitt, American statesman: b. Boscawen, N. H., 16 Oct. 1806; d. Portland, Maine, 8 Sept. 1869. He was graduated at Bowdoin College in 1823 and admitted to the bar in 1827. He entered politics and soon acquired a national reputation as a lawyer and a Whig. He was elected to the United States Senate in 1854, and a week after he took his seat made a speech against the Kansas-Nebraska Bill which placed him in the front rank of senatorial orators. During the Civil War he was conspicuous for his efforts to sustain the national credit. He was made secretary of the treasury in 1864, and, having placed it on a firm basis, resigned in 1865 to return to his seat in the Senate.

Festa, Costanzo, cōs-tăn'zō fes'tä, Italian composer: b. Rome about 1496; d. there 10 April 1545. He became a member of the pontifical choir 1517, and composed much church music, many madrigals for three voices, motets, and litanies, many of his manuscript scores being still preserved in the archives of the pontifical chapel and the Vatican. His ‹Te Deum› is sung at the election of new popes, the appointment of new cardinals, and at the Festival of the Holy Sacrament. It was published in Rome 1596.

Festivals. See Feast.

Festus, Porcius, por'shius fes'tus, Roman procurator in Palestine about 60–62 A.D. It was he before whom St. Paul was accused by the Jews; but the apostle appealing to the emperor, Festus sent him to Rome.

Festus, Sextus Pompeius, sex'tus pompē'yus fes'tus, Roman grammarian of the 3d or 4th century of our era, author of an abridgment of a work by Verrius Flaccus, called ‹De Verborum Significatione,› a kind of dictionary, very valuable for the information it contains about the Latin language. The original work of Festus has been preserved only in imperfect MS., now at Naples, but it is more fully preserved in the abridgment made by Paul Diaconus.

Fet, A., the pseudonym of Schenschin, Afanassij Afanasjewitch (q.v.).

Fetial, or **Fecial,** fē'shial, one of a college of priests in ancient Rome, said to have been instituted by Numa, consisting of 20 members, who presided over all the ceremonies connected with the ratification of peace or the formal declaration of war, including the preliminary demand for satisfaction, as well as the actual denunciation of hostilities. Their chief was termed Pater Patratus. When sent to a distance to conclude a treaty, they carried with them certain sacred herbs called verbenæ, or sagmina, which were gathered on the Capitoline Hill, and which were considered indispensable in their rites.

Fetishism, or **Fetichism,** fē'tish-izm, the worship of material things (fetishes) as the abodes of spirits, or more strictly the belief that the possession of a thing can procure the services of a spirit lodged within it. It is the lowest of the unsystematic forms of worship found among uncivilized tribes, and exists especially among the negroes in Africa, but also among the natives of both Americas, the Polynesians, Australians, and Siberians. The word itself is ultimately due to the Portuguese, the first Europeans to trade on the west coast of Africa, who expressed their conception of the religion of the natives by the Portuguese word *feitiçāo*, «magic.» Comte used it as a term to describe what he believed to be a necessary stage in the development of all religions in which all external bodies, natural, or artificial, are supposed to be animated by souls essentially analogous to our own. Any object may become a fetish, provided it is capable of being appropriated literally or metaphorically by an individual. Such objects are flints, shells, claws, feathers, earth, salt, plants, manufactured articles, anything peculiar or unknown or not understood, trees, streams, rocks, and even certain animals, as the serpents of Whydah. It is enough for an object to be accidentally associated with an event for it to be regarded as the cause and even the author of that event, whence its elevation to the rank of a fetish. Fetishes may be natural or artificial. Artificial fetishes are either public, preserved by priests, or private, purchasable from them usually at a very high price. In some countries kings and princes have large collections of fetishes, and every family has at least one. They are hereditary, and either hung up in the dwellings or worn on the neck or elsewhere, and are even fastened on domestic animals. They are made to resemble the human form, and the public fetishes are sometimes of gold and very large. The worshippers provide their fetishes liberally with food, but if prayers are not granted they frequently maltreat them, throw them away, or beat them to pieces. In connection with fetish worship there are festivals and sacrifices. For the latter the victims are oxen, swine, and other animals; but sometimes, when the royal and priestly power are united in the sacrificer, criminals, prisoners, or persons of the lowest classes of the tribe are immolated. The festivals — among which the Yam and Adai festival with the Ashantees, and the festival in honor of Khimavong, the god or divine messenger, are especially celebrated — are generally attended by excess in drinking, thefts, fights, and gross licentiousness. The priests form a separate society, with hereditary dignity, property, and privileges. They have in particular the right of retaining the slaves who come to them, or, as they call it, present their bodies to the fetish. See De Brosses, ‘Du culte des dieux fétiches’ (Dijon 1760), through whom the terms fetish and fetishism were introduced into the history of religious worship. It must, however, be observed that the limits of the term fetish have not yet been agreed upon, as some exclude from it the worship of forests, mountains, rivers, etc. In the luck tokens of gamblers and other superstitious persons there is an analogy to the fetish of the savage. See FAMILIAR SPIRIT; WITCHCRAFT.

Fétis, François Joseph, frän-swä zhō-zef fā-tēs, Belgian musical composer: b. Mons, Belgium, 25 March 1784; d. Brussels 26 March 1871. He published: ‘Histoire générale de la musique’; ‘Biographie universelle des musiciens’ (1834–44); etc., and founded and edited the ‘Revue Musicale.’ His most popular opera was ‘La vielle’ (1826).

Fetor, fē'tòr, a peculiarly offensive odor, usually considered to be due to some sort of animal putrefaction. Fetor of the breath may be due to sores of the tongue, cheeks, or gums, to necrosis of the teeth or abcess of the teeth cavities, to poisoning of mercury and the sordes of scurvy. Diphtheretic and streptococus inflammations of the throat cause bad odors that closely resemble fetor. Gangrene and abscess of the lungs cause the most persistent and penetrating fetor. In various diseases of the stomach and intestines accompanied by the absorption of products of putrefaction, fetor of the breath is common. Fetor of the feet is due to lack of porosity of their leather covering and to uncleanliness and excessive perspiration. These conditions result in a maceration of the skin and if infection with certain forms of bacteria takes place this macerated skin is apt to be infected with putrefactive bacteria and consequent upon this is more or less fetor. The treatment of the condition consists in cleanliness, improvement of the foot-gear and antiseptic washes.

Fet'terolf, Adam H., American educator: b. Perkiomen, Pa., 24 Nov. 1841. He was educated at Ursinus College; became vice-president of Girard College in Philadelphia in 1880, and president in 1882.

Feuchtwanger, foiнt'vang'-ĕr, **Lewis,** American chemist: b. Furth, Bavaria, 11 Jan. 1805; d. 25 June 1876. He early displayed a fondness for natural science and made that study a specialty at the Jena University. In 1829 he came to New York, where he opened its first German pharmacy. He soon won a reputation as a chemist, mineralogist, and manufacturer of rare chemicals. He was the first to introduce the alloy, German silver. His works are: ‘Popular Treatise on Gems’ (1838); ‘Elements of Mineralogy’ (1839); ‘Treatise on Fermented Liquors’ (1858); ‘Practical Treatise on Soluble or Water Glass’ (1870).

Feudal System. A fee, feud, or fief is a possession, of which the vassal receives the right of use and enjoyment, of disposition and alienation, on condition of fidelity, that is, of affording assistance or counsel, and avoiding all injurious acts, together with the performance of certain services incident to the tenure, while the feudal lord still retains a paramount right. A fief is distinguished from allodial possessions by the circumstance that it cannot be alienated without the consent of the feudal lord, by the services usually due from the vassal, and by a peculiar kind of inheritance. The system originated among the German tribes, and the nature of feudal property is explained by its origin. Such was the passion of the ancient Germans for war, that in time of peace private feuds took the place of public contention; and in default of these the men of military age spent weeks and months and years in adventures, and made incursions into the territory of the neighboring tribes, or took part in the quarrels of the distant ones. In the expeditions of particular adventurers against the adjacent tribes or the Roman provinces, their booty consisted of garments, arms, furniture, slaves. But when the northern hordes broke into the south, and in the partition of the conquered lands large districts fell into the hands of kings or dukes and their subordinates, they gave certain portions of the territory to their attendants to enjoy the possession for life. These estates were called *beneficia* or fiefs, because they were only lent to their possessors, to revert after their death to the grantor, who immediately gave them to another of his servants. From this custom of the ancient Germans arose the feudal system and feudal service, which is purely German. As the son commonly esteemed it his duty, or was forced by necessity, to devote his arm to the lord in whose service his father had lived, he also received his father's fief; or rather, he was invested with it anew. By the usage of centuries this custom became a right; and to deprive one of his paternal fief, though it was prohibited by no law, seemed an act of injustice. This change took place between the 9th and 11th centuries. A fief rendered vacant by the death of the holder was at once taken possession of by his son, on the sole condition of paying homage to the feudal superior. In the case of ecclesiastical fiefs the right of succession belonged, under the same condition, to those who succeeded the last holders in their ecclesiastical office. The castle-fiefs, so called, were a peculiar kind of military fiefs, the possessor of which was bound to defend the castle belonging to his lord. The vassal who directed the defense was called, in the imperial fortresses, a burgrave. Thus the several orders of vassals formed a system of concentric circles, of which each was under the influence of the next, and all moved around a common centre, the king, as the supreme feudal lord. With military vassals another class arose. From the oldest times in the courts of kings and the governors whom they appointed, as well as in those of the bishops, were certain officers who at first performed active service, but were afterward rather a splendid appendage to the court. The four offices of the marshal, the chamberlain, the cup-bearer, and the sewer, are the oldest and most honorable, but by no means the only ones; offices, on the contrary, were as numerous as the employments which could be devised at court. These officers, at a period when money was scarce and the old German notion in full vigor which considered none but landed proprietors as citizens, and none but the owners of large estates as noblemen, were naturally rewarded by grants of land during the time of service; and these estates, like the military fiefs, but somewhat later, certainly not before the time of Frederick I. (1152–90), became by degrees hereditary. The splendor of the court, and the advantages accruing from these services, induced many noblemen to solicit them. They became the first in the new class of servants or ministers which was thus formed; and under them there was a multitude of other servants, particularly on the estates of the nobility.

A refusal to perform feudal serivce, or any other violation of fealty, was styled felony. Upon this and other difficulties incident to feudal property, as in cases growing out of the succession, surrender, alienation, or under-tenure of a fief, the lord decided in a feudal court, filled by vassals, who were required to be of equal rank with the accused. To appear in these courts at the summons of the lord of the manor, and accept the place of an assessor there, was reckoned among the duties incident to a fief. As the relation of lords and vassals (at that time one of the most important relations in life) became more and more widely spread, and the number of vassals increased at the expense of the ancient immediate subjects of the empire, the latter were thrown into the background, and at length nearly forgotten.

In the 10th and 11th centuries no duty due from subjects was known except feudal duties; the whole German empire was one vast feudal possession, and the ideas of feudal lords and national sovereigns were wholly confounded. If any one was neither a lord nor a vassal he was scarcely looked upon as a citizen. Hence few rich landed proprietors ventured to rely upon their own strength, without a feudal connection. And even most of these at last yielded to the spirit of the age, and became royal vassals. The emperor, likewise, used every means to induce them to adopt such a course.

From the feudal system, the only social organization of the European states in the Middle Ages, a new system of civil rank arose. The inferior nobility, a rank intermediate between the higher nobility (princes) and freemen, owes its origin, it is said, to this institution; and a regular scale of rank was formed among the vassals, without detriment, however, to the principle of equal birth. The king formed the first class; the spiritual princes, bishops, and immediate abbots constituted the second; the lay princes, dukes, landgraves, margraves, and immediate counts, the third; those barons, or rich landed proprietors, who owed fealty to no one, but yet, on account of their limited rights or possessions, were the vassals of the emperor, the fourth; those freemen who stood in the same relation to the princes, the fifth; the vassals of the former and the servants of the princes, the sixth; and the possessors of small fiefs, the seventh. Besides these ranks, after some centuries, the order of citizens was formed, as being included under no one of them. The spirit of the feudal system, grounded on the prevalence of landed property, was necessarily foreign to cities which owed their origin to industry and personal property, and founded thereon a new sort of power. The principles of the feudal laws were developed and established by the Lombard lawyers of the 12th century. The collection of feudal laws and customs which is appended to the Roman code under the title of *Libri Feudorum* became the code of feudal law over a great part of Europe.

The feudal form of government, at a period when a spirit of independence and of opposition to despotism was abroad in the land, was well suited to put into the hands of one governor, as supreme feudal lord, the reins of the national power, to be employed against foreign enemies without endangering domestic freedom. But the purity and influence of feudal relations in time became less; and the strength of the national government declined amidst a spirit of disaffection and sedition, which became universal when nobles began to perceive that the feudal government was not naturally dependent on kings, but kings on it. Indeed, the sovereigns had no other security for their subjection than the feudal oath and the menaces of punishment, which the king might not have the ability to carry into effect, when his power was divided in most of his states, either by investiture or by the usurpations of the princes. Thus the vassals of the crown in Germany, Italy, and the older districts of France succeeded in depriving the king of almost all power, even of the external honors of royalty; and never, in the two first countries, and in France only after the extinction of the great baronial families, could he succeed in establishing a new authority independent of the feudal power. See MIDDLE AGES.

Feuerbach, Ludwig Andreas, lood'viH än'drā-äs foi'ĕr-bäH, German philosopher: b. Landshut 28 July 1804; d. near Nuremberg 13 Sept. 1872. He was the son of Paul Feuerbach (q.v.). He was a Hegelian and materialist whose opinions hindered a professional career, and who devoted himself to metaphysics in retirement. His masterpiece, ‘Das Wesen des Christenthums’ (1841) was translated by George Eliot into English as ‘The Essence of Christianity.’ In his ‘Theogonie’ (2d ed. 1866), he deals with worship from the historical standpoint. Other works of his are: ‘History of Modern Philosophy from Bacon to Spinoza’ (1833); ‘Criticism of the Philosophy of Leibnitz’ (1837); ‘Pierre Bayle’ (1838); ‘Principles of the Philosophy of the Future’ (1843); ‘The Essence of Religion’ (1845). See Lives by Beyer (1873); Grün (1874); Starcke (1885).

Feuerbach, Paul Johann Anselm von, powl yō'hän än'zelm fon, German jurist and criminal law reformer: b. Hainichen, near Jena, 14 Nov. 1775; d. Frankfort-on-Main 29 May 1833. Among his best-known works are: ‘Critique of Natural Law’ (1796); ‘Anti-Hobbes’ (1798); ‘Lehrbuch des gemeinen in Deutschland geltenden peinlichen Privatrechts’ (1801); ‘Merkwürdige Kriminalsrechtsfälle’ (1808–11); ‘Kaspar Hauser: An Instance of a Crime Against a Soul’ (1832).

Feuillants, fė-yoṅ, in ecclesiastical history, a religious order clothed in white and going barefoot, who lived under the strict observance of the rule of St. Bernard. The name was occasioned by a reform of the order of Cistercians (1577), first made in the abbey of Feuillens, a Cistercian abbey in Guienne. There were also convents of nuns who followed the same reform, called *Feuillantines.* The first of them was established near Toulouse in 1590. Eleven years later the order transferred its headquarters to Paris, and continued to flourish until suppressed, along with other religious orders, by the Revolution of 1789. The monastery was taken possession of by a club celebrated in the political history of France under the name of the Feuillants, and of which Mirabeau was a member. It was a weak rival of the Jacobin club, and fell before the clamor of a mob in 1791.

Feuillet, Octave, ōk-täv fė-yā, French novelist and dramatist: b. Saint Lô, Manche, 11 Aug. 1812; d. Paris 29 Dec. 1890. Between 1845 and 1858 he gained a good deal of notice with his novels and a series of comedies and tales, some of which were published in the Revue des Deux Mondes. In 1857 the appearance of ‘Le Roman d'un Jeune Homme Pauvre’ raised Feuillet to the first rank of the novelists of the day, and was immediately dramatized by the author himself. Next followed ‘Histoire de Sibylle’ (1862), and in the year in which it appeared Feuillet was elected to the French Academy, succeeding to the fauteuil of Scribe. Among his other numerous novels are: ‘Monsieur de Camors’ (1867); ‘Julia de Trécœur’ (1872); ‘Un Mariage dans le Monde’ (1875); ‘Le Journal d'une Femme’ (1878); ‘Histoire d'une Parisienne’ (1882); ‘La Morte’ (1886); ‘Le Divorce de Juliette’ (1884); ‘Honneur d'Artiste’ (1890). His works have a refined humor, and are free, especially the earlier, from coarseness. His dramas also met with considerable success, but they are on the whole inferior to his novels. Feuillet's ‘Théâtre Complet’ appeared in 1892–3. He was succeeded in the Academy by Pierre Loti.

Féval, Paul Henri Corentin, pōl oṅ-rē cō-roṅ-tăṅ fā väl, French novelist: b. Rennes 27 Sept. 1817; d. Paris 8 March 1887. His first story, ‘The Seals' Club’ (1841), and others, having given him some note, he was offered a large sum to write, under the pseudonym “FRANCIS TROLLOPE” (as though an Englishman), a sensational story ‘The Mysteries of London,’ after the manner of Sue's ‘Mysteries of Paris.’ It was done in 11 volumes, was immensely successful, widely translated, and put on the stage. He remained a very fertile, spirited, and popular writer, often dramatized, with long runs. Especially successful were: ‘The Son of the Devil’ (1847); ‘The Hunchback’ (1858); ‘Mrs. Gil Blas’; ‘The Last Man Alive’ (1873); ‘The Wonders of Mount St. Michael’ (1879). At first a Free-thinker, in his later years he became an ardent Catholic.

Fever, a condition in which the temperature of the body is above normal. The average daily range of temperature in men is from 98° to 99° F., and in women from quarter to half a degree higher. In children temporary elevation even as high as 100° F. may occur from conditions of excitement and from over-exercise, but this should not be termed fever. Slight daily variations in temperature are usual. Thus the maximum temperature occurs usually from 5 to 9 P.M. There is then, as a rule, during sleep a decrease until a minimum is reached, some time between 2 and 4 A.M. It is probable that diminished muscular activity and lessened food absorption are responsible for much of this variation. Temperature usually rises during strong muscular exercise, and also after a meal. These slight rises are balanced by heat-loss from increased perspiration. The temperature of man in the tropics and in the Arctic zone does not vary more than 1° C. (For discussion of bearable extremes of heat and cold, heat-production, heat-loss, and the nervous mechanism that controls the general phenomena, see ANIMAL HEAT.)

Modern pathology teaches that fever is the index of a reaction of the human body in its struggle with some foreign invader, and is brought about by excessive oxidation and diminished heat-loss. Fever is usually accompanied by an increase in the number of respirations, by an increased number of contractions of the heart, raised pulse-rate, an increase in the blood-tension in the blood vessels, and by other symptoms of general malaise. These are headache, dry mouth, dry skin, and at times increased mental excitement. Fever from this point of view is a conservative process, and is nature's own method of overcoming some form of infection or intoxication Fever as a general process should be distinguished from the many special kinds of so-called fevers that are described. Thus the term fever as used in typhoid fever, scarlet fever, lung fever, etc., is a relic of earlier medical teachings, in which the rise in temperature was considered the essential part of the disease. It is now recognized that fever is only one of the features in the general history of the development of the disease-process. The height of the temperature during fever may vary considerably. If the temperature is not above 100° F. (37.7° C.), it is spoken of as light fever; when between 100° and 103° F. (37.7° and 39.4° C.) it is called moderate fever; between 103° and 105° F. (39.4° and 40.5° C.) it is spoken of as high fever; while above 105° F. (40.5° C.) hyperpyrexia is the term that is applied. Temperatures as high as 110° F. have been recorded in patients who have recovered. The course of most fevers is, for purposes of convenience, divided into (1) the initial stage, which usually starts with chilliness and often with a distinct chill; (2) the hot stage, when the temperature has risen and is at a fairly constant normal, during which the blood vessels at the surface are dilated, the skin is flushed and feels hot and dry; this condition perhaps lasting a few hours, or it may be several weeks, according to the disease-processes that produce it; and (3) the terminal stage. This may be ushered in by a previous perspiration, with sometimes increased urination and prompt subsidence of the temperature; or the temperature may slowly sink to normal by a process of lysis (q.v.). Each type of disease-process manifests its own peculiar temperature-variation, and the study of temperature-curves is extremely important in the determination of the disease.

Fever results not so much from an increase in the heat-production alone, but in a disturbance of the heat-regulation or thermotaxis (q.v.); for it is perhaps true that the amount of heat produced by an athlete in a mile run is vastly greater than that produced throughout the entire four weeks of a severe typhoid fever yet the heat-loss keeps pace in the runner with the heat-production. It is the relation between these two factors that is disturbed in fever. Fever is largely a conservative process, and a moderate degree of temperature is believed to be rather beneficial than harmful. The real danger in fever is not the temperature, unless it is excessively high — from 104° to 105° F. — but it is the poison that is being made in the body, either by perverted metabolism or by bacterial or chemical intoxication. Therefore, in the treatment of disease with rise in temperature the reduction of the fever is not the only point to be attained. During fever there is increased oxidation, increased elimination of uric acid, diminution of most of the secretions, notably the saliva, the gastric juice, the bile and, save in the terminal stages, the sweat. The kidney-secretion is also decreased during the hot stage, because more water is being lost through the skin and lungs than usual. Changes in the blood are constant, and usually consist in an increase in the number of leucocytes, or white blood-cells. High temperatures may produce degeneration in a number of tissues of the human body. The most important ones are those of the nerve-cells. These changes may take place if the temperature gets above 105° F., and even lower temperatures acting for a very long time may cause serious structural changes in the nervous system. The treatment of fever, as has been indicated, should mean the treatment of the disease that is causing the fever, and will be considered under each particular topic of fever. Consult: Hektoen, ‘American Text-book of Pathology’ (1901); Schäfer, ‘Text-book of Physiology’ (1900). See MALARIA; RELAPSING FEVER; SCARLET FEVER; TYPHOID FEVER; YELLOW FEVER.

Fever-bush (*Benzoin benzoin*), an American shrub of the laurel family (*Lauraceæ*). It grows from 4 to 20 feet high, in moist woods and along streams from Massachusetts, through Ontario, to Michigan, south to Kansas, and eastward to North Carolina. An infusion of the sweet-smelling bark is used as a tonic in fevers. The bright berries of the tree, ripe in August and September, are sometimes ground and used as spice, for which reason it is locally called spice-bush or wild allspice. It is also known as Benjamin-bush. The name fever-bush is also applied to the *Ilex verticillata.*

Feverwort (*Triosteum perfoliatum*), a perennial of the honeysuckle family (*Caprifoliaceæ*), a native of North America, where its dried and roasted berries have been occasionally used as a substitute for coffee; its roots act as an emetic and mild cathartic. The plant grows in rich soil from Quebec westward to Minnesota, and south to Kansas, Kentucky, and Alabama. It has a number of common names, and is known locally as fever-root, horse-gentian, wood ipecac, tinker's root, wild coffee, etc.

Fewkes, fūks, **Jesse Walter,** American anthropologist: b. Newton, Mass., 14 Nov. 1850. He was graduated from Harvard in 1875, and was for 10 years associated with Alexander Agassiz in the Marine Laboratory at Newport, R. I. Since 1895 he has been connected with the Smithsonian Institution, and has written extensively on professional themes, his papers having usually appeared in the ‘Proceedings’ of the many scientific societies of which he is a member. He edited the ‘Journal of American Ethnology and Archæology’ 1891–4.

Feydeau, Ernest Aimé, ĕr-nest ā-mā fā'dō, French novelist: b. Paris 16 March 1821; d. there 29 Oct. 1873. His realistic story ‘Fanny’ (1858) had an unprecedented success. It was followed by ‘Daniel’ (1859); ‘Catherine d'Overmeire’ (1860); ‘Sylvie’ (1861); and ‘A Début at the Opera’ (1863). Of his later works one only had any marked success, ‘The Countess de Chalis, or the Morals of Our Day’ (1868).

Feyen, Eugène, ė-zhen fā-yāṅ, French painter: b. Bey-sur-Seille, Meurthe-et-Moselle, France, 13 Nov. 1815. One of the many successful pupils of Paul Delaroche. He was awarded a second class medal at the Salon in 1880, a third class medal at the Paris Exposition 1889, and the cross of the Legion of Honor in 1881. While he began as a painter of portraits and of the nude, he gradually drifted into genre subjects, which are evidently congenial to his talent, and his pictures of the seaside and the fisher folk are distinguished for clever composition and refreshing color. ‘The Harvesters of the Sea’ (1872), (in the Luxembourg); ‘The Bay of Cancale’ (1885); and ‘The Sailor's Sweetheart’ (1890) are his best works.

Feyer-Perrin, François Nicolas Augustin, frāṅ-swä nï-kō-lä ō-güs-tăṅ fā-yā pĕ-răṅ, French painter: b. Bey-sur-Seille, Meurthe-et-Moselle, 1829; d. Paris 14 Oct. 1888. He began his career as an artist in the drawing school at Nancy and subsequently attached himself to the studios of Cogniet and Delaroche at Paris. At first he hesitated in choosing a specialty between subjects of poetic allegory, genre subjects, or varying race type, or historic painting. Since 1864 he has confined himself to painting the scenery and people of the seashore, especially in Brittany. His work has been successful, because it is distinguished by poetic feeling, delicate characterization and transparently brilliant coloring. His most famous pictures are in the Luxembourg, namely, ‘The Return from Oyster-fishing’ (1874) and ‘The Fisher-girls of Cancale at the Spring’ (1873).

Fez, fĕz, **Kingdom of,** once independent, but now the most northern section of the empire of Morocco; bounded north by the Mediterranean; east by Algeria; south by the river Om-er-begh or Morbeza, which separates it from Morocco proper; and west by the Atlantic. It was conquered and united to Morocco in 1548. See MOROCCO.

Fez, Morocco, city, capital of the province of Fez; 95 miles from the Atlantic, 225 northeast of Morocco. Fez contains over 100 mosques, one, El Carubin, has a covered place for women who may choose to participate in public prayers, something unusual in Mohammedan places of worship. Good public baths are numerous. Its chief manufactures are leather, red caps (fez), and silk shawls. Twice a year caravans go from Fez across the desert to Timbuktu. Fez has always been considered one of the chief seats of Moslem learning. Old Fez was founded in 793 by Edris II., a descendant of Mohammed, and continued the capital of an independent kingdom till 1548, when it was, together with its territory, conquered and annexed to Morocco. Fez has always been held so sacred by the Arabs and others, that when the pilgrimages to Mecca were interrupted in the 10th century, the western Moslems journeyed to this city, as the eastern did to Mecca; and even now none but the Faithful can enter Fez without express permission from the emperor. Pop. (estimated) 140,000.

Fezandié, fā-zäṅ-dī-ā, **Clement,** American educator: b. New York 15 Sept. 1865. He has been scientific instructor in New York schools and has published: ‘Through the Earth’ (1898); ‘Two New Jersey Crusoes’ (1901).

Fezzan, fez-zän', Africa, a province in the southern part of the Turkish vilayet of Tripoli; area about 150,200 square miles. In the northern part are low mountains, or hills, one of which, Jebel-es-Sudah, or Black Mountain, is composed largely of basalt. Sandy plains and a few fertile valleys are in the southern part. There are no streams of water and but few natural springs; but good water may be obtained at a depth of from 10 to 12 feet. There are a few small lakes, usually covered with a thin crust of carbonate of soda. Rain seldom falls; in some places years intervene between the short periods of rainfall. Jackals, gazelles, and foxes, the ostrich, vulture, and falcon are found in the hills. The manufactures are coarse linen and cotton goods and some ornamental articles made from gold and silver. Trade with neighboring cities is carried on by means of caravans. Pop. (estimated) 50,000.

Fiacre, fē ä'kėr (Fr. pron. fyä kr), or **Fiachrach, Saint,** French monk; d. about 670. He was of Irish birth and settled near Meaux in France, building a small monastery there. From the 9th to the 17th century was famed as a worker of miracles, especially as curing a kind of tumor. His shrine, ultimately deposited in the cathedral of Meaux, was long an object of pilgrimage. The first livery stable in Paris was established in 1641 by the owner of the Hotel de Saint Fiacre. From the fact that a statue of the saint stood above the door the term fiacre, as the name of a public carriage, is derived.

Fiat, fī'ăt, an order of a judge or of an officer whose authority, to be signified by his signature, is necessary to authenticate particular acts; a short order or warrant of the judge, commanding that something shall be done. See 1 Tidd, Pr. 100, 108. Fiat in bankruptcy, in English law, was an order of the lord chancellor that a commission of bankruptcy should issue. Fiats in bankruptcy are abolished by 12 and 13 Vict. c. 116.

Fibiger, fē'bĭ-gėr, **Johannes Henrik Tauber,** Danish poet and clergyman: b. Nykjöbing 27 Jan. 1821. He wrote dramas founded on biblical history: ‘Jephtha's Daughter’ (1849); ‘Jeremiah’ (1850); ‘John the Baptist’ (1857); also a few secular tragedies, the most notable among them being: ‘Cross and Love’ (1858) and ‘The Everlasting Struggle’ (1866), which has been very popular; and a narrative poem in 16 cantos, ‘The Gray Friars’ (1882).

Fibonacci, Leonardo, lā-ō-nar'dō, fē-bō-nä'chē, called **Leonardo Pisano,** Italian mathematician: b. Pisa about 1180; d. about 1228. Little is known of his life except from his writings, which were collected 1857–62 by Prince Boncompagni and include: ‘Liber Abaci’ (1202); ‘Practical Geometriæ’ (1220); ‘Liber quadratorum’ (1225); ‘Flos’; ‘A Letter to Theodore.’ He traveled in Egypt, Syria, Greece, Sicily, and elsewhere, placing himself wherever he journeyed in communication with the leading mathematicians of the region visited. The ‘Series of Fibonacci,’ sometimes called the ‘Series of Lame,’ is as follows: 0, 1, 1, 2, 3, 5, 8, 13, 21, 34 — each term being equal to the sum of the two which precede it, indicated algebraically as $\frac{U}{n+2} = \frac{U}{n+1} + \frac{U}{n}$, and having several other remarkable characteristics important in higher arithmetic.

Fibre. Vegetable fibre is derived from the cellular structure or tissue of plants, the cells of which vary in diameter from one three-hundredth to one five-hundredth of an inch, the smaller sizes admitting of 125,000,000 cells to a cubic inch. The walls of these cells are composed of a starch-like substance called cellulose, enclosing the life principle or germ of the plant, known as protoplasm. There are three forms of cells, simple cells, woody cells, and ducts. Woody fibre is formed by the lengthening and thickening of simple cells. The ducts or vessels are large cylindrical cells whose walls have been absorbed and broken away. Wood cells consist of tubes one or two thousandths of an inch in diameter, their ends pointed and overlapping, so that when detached they form a continuous thread of cell structure or fibre proper, such as a filament of flax; and when they occur in the bark of dicotyledonous plants, or exogens, they are known as *bast* fibre. In monocotyledons, like the palms, and the century plant, the fibrous cells are built up with vessels into a composite structure known as «fibrovascular bundle.» These bundles of elongated, thickened cells pressed firmly together, and often embedded in soft cellular tissue, so to speak, the bones or structural part of the plant, are called *structural* fibres, sisal hemp being an example. Even the common or simple cells form a valuable fibre material when they are produced on the surfaces of the leaves, stems and seeds of plants, in the form of hairs. This form of fibrous substance is known as *surface* fibre, cotton being an example. In this instance the hairs envelop the seeds produced in the boll or capsule. The «down» on the stems and surfaces of the leaves of plants is another example.

The term fibre is also given to other forms of vegetable growth where the fibrous material is not employed in the form of detached filaments, like flax sisal and cotton. The stems and twigs, and even wood of exogenous trees, divided into splints, and used for basket-making are recognized as fibre; and in like manner the stems and leaves of endogenous plants split or used entire, as rattan, or when coarsely subdivided for plaiting into such articles as hats, mats, etc., are also classed as fibre. The stripped epidermis of palm leaves, such as the raffia of commerce, is considered fibre, yet it is not in any sense filamentous. Even some species of mosses, marine weeds and fungous growths, on account of their economic employment are regarded as fibre substitutes, and are mentioned in the category of fibres. In general terms, however, «fibre» is composed of bundles of bast or fibrovascular tissue in the form of long flexible filaments, such as flax, hemp or. manila; or of hairs, such as cotton, capable of being twisted or spun into yarns or threads, to be manufactured into fabrics or cordage.

The following classification illustrates the different forms of fibrous material recognized by experts, and shows the positions of the different fibres in their relations to each other:

All fibrous material is classed in two grand divisions: A, Fibrovascular structure and, B, simple cellular structure. A is again divided into three groups: (1) Bast fibres; (2) Woody fibres, and (3) Structural fibres: B is divided into two groups, (4) Surface fibres, and (5) Pseudo-fibres or false fibrous material.

1. The bast fibres are derived from the inner fibrous bark of dicotyledonous plants, and are composed of bast cells, their ends overlapping to form in mass a continuous filament. Their utility is to give strength and flexibility to the tissue.

2. Woody fibres may be: (a) the stems and twigs of exogenous plants, or (b) the roots of exogenous plants entire, or subdivided into withes for use in basketry or a rough kind of cordage, or for coarse thread for stitching and binding (as in canoe manufacture); or (c) the wood of exogenous trees reduced to layers or splints, for baskets, or for excelsior; or (d) the wood of certain exogenous trees reduced to pulp for paper.

3. Structural fibres are derived (a) from the structural system of the stalks, leaf stems and leaves of monocotyledonous plants (as the agaves and palms) occurring as isolated fibrovascular bundles, surrounded by a pithy, spongy, corky, or often soft cellular mass, covered with a thick epidermis. They give the plants rigidity and also serve as water vessels; or (b) the entire stems or leaves of the same plants, simply split or shredded (such as straw plait); or (c) the fibrous portions of the leaves or fruits of certain exogenous plants when deprived of their epidermis and soft cellular tissue (the vegetable wool from pine needles).

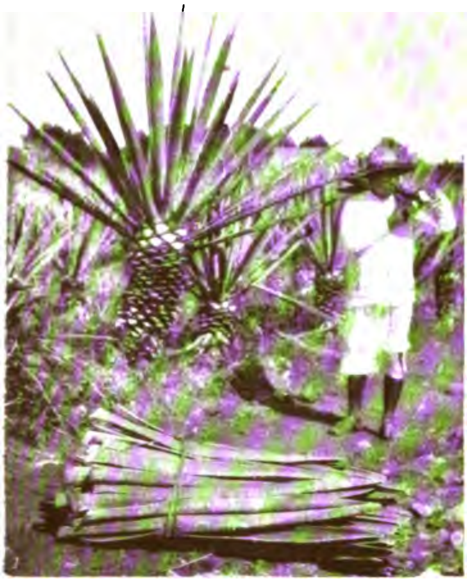
Under division B, simple cellular structure, the (4) Surface fibres are recognized as (a) the hairs surrounding the seeds or seed envelopes of exogenous plants, and usually contained in a pod or capsule (as cotton); (b) hair-like growths, or tomentum, produced on the surfaces of stems, leaves, or leaf-buds of plants (as pulu); or (c) fibrous material produced in the form of epidermal strips from the endogens (as raffia). The (5) Pseudo-fibres, strictly speaking are not fibres, but false fibrous material employed as substitutes for the true fibres. These are: (a) certain mosses, used as packing substances; (b) certain leaves and marine weeds, also used for packing; (c) seaweeds wrought into fish-lines or cordage, and (d) fungus growths employed in some of the economic uses to which true fibres are put.

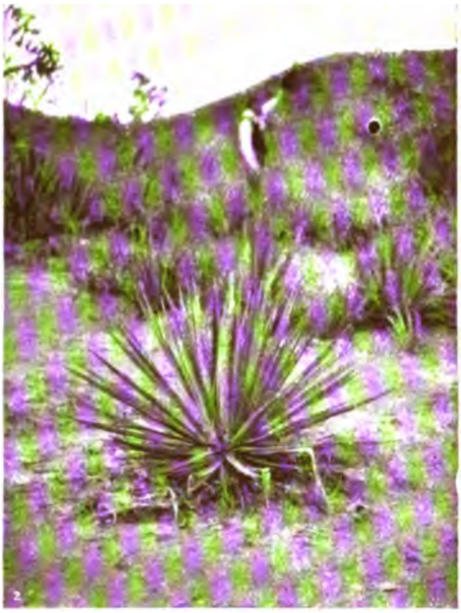
A review of the uses of fibres in the arts, by man, shows seven general classes of economic employment, each of which may be subdivided, further, to illustrate special utility.

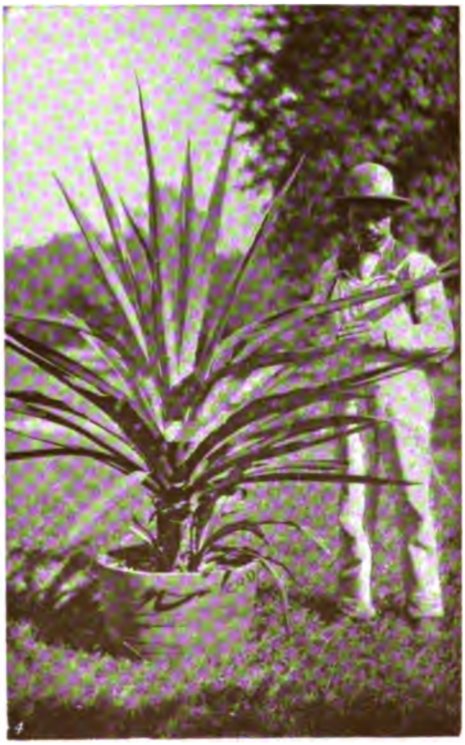
1. *The Spinning Fibres* enter into the highest forms of manufacture, such as the production of cloth and woven or netted fabrics, and they also include the cordage fibres. Among spinning fibres those for the production of fabrics naturally are the most important commercially. The fibres of the first rank, which enter into fine and coarse textures for wearing apparel, house furnishings, awnings, sails, etc., are chiefly cotton, flax, hemp, ramie, pineapple fibre, and the finer manila hemps; those of the second rank, jute, cocoanut fibre and some of the Agaves find use in burlap or gunny, webbing, rough sacks, coarse floor coverings, etc. The netting fibres, also included in the spinning fibres, are derived from a very much wider range of plants, many of which are not in cultivation. Besides cotton, flax and ramie, employed chiefly in laces and knit goods, nets, etc., there are scores of tree basts, Agave, palm and grass fibres, which find use, both commercial and native, in the manufacture of all kinds of nets, hammocks and similar articles. A third group of the spinning fibres comprises those employed in cordage manufacture. They include all of the fabric fibres mentioned above, the so-called hard fibres, Manila and sisal hemps, coir, etc., as well as Sunn hemp, Mauritius, the bowstring hemps, New Zealand flax, Tampico, and many forms of fibre used in the hand manufacture of rope, by natives, in their rude domestic economy.

2. *Tie Material.*— The fibres employed as tie material are legion; many of them can scarcely be called commercial forms as they are largely used by the natives in the countries where they are produced. The tie material is usually the peeled bark of trees rich in bast, stripped or shredded palm leaves, the tougher grasses, and even twigs and roots used with no special preparation, but merely twisted when green, or freshly cut, into rough cordage for the building of huts, enclosures, and even for constructing rope suspension bridges. Raffia, used

FIBRE PLANTS—I







1. Sisal Hemp.
2. Istle or Tampico Hemp.
3. Cocoanut Plant.
4. Mauritius Hemp.

by nurserymen as a ready-to-hand tying material, is an example.

3. *Natural Textures.*— These are the nature-woven fabrics of tropical countries, which are used as substitutes for cloth, and which are prepared by simply stripping from the plant, in sheets or layers of fibrous substances, and beating. The famous Tappa cloth of the Pacific Islands is an example. Others are the lace barks, the satin-like Cuba bast, employed in ladies' hats, the ribbon-like bast used for cigar wrappers, etc.; also the fibrous sheaths from the bases of the leaf-stalks of palms. The separated and hand-twisted filaments of many of these cloth substitutes are also used for rough cordage.

4. *The Brush Fibres.*—These include such commercial forms as Tampico, Palmetto, Palmyra, Kitool, Monkey Bass, Piassaba, and cocoa fibre, employed in the manufacture of brushes, and as substitutes for animal bristles, as well as the coarser forms, such as broom-corn, broom-root and even twigs and splints as employed in street-sweeping machines.

5. *The Plaiting and Rough Weaving Fibres.*— This is another large group, which includes a wide range of uses not commercial, yet of greatest importance to the natives of the countries where they grow. They are employed in articles of attire and ornament and for use in the domestic economy. The most important commercially are the straw-plaits from wheat, rye, barley and rice straw (the Tuscan and Japanese braids). Other forms are split from palm leaves, such as *Carludovica palmata,* used in weaving Panama hats; plaits are also produced from various fibrous substances used entire, as the tree basts, and even thin shavings of close-grained woods — the «chip» in millinery trimmings. This group also includes the commercial matting fibres produced from grasses and sedges, as well as thatch materials of every description. The basketry fibres are likewise classed in this group, and they are legion, for they include not only the entire range of palm fibres, the grasses, reeds and rushes, yucca fibre, the leaf stems of ferns, etc., but osier and splints from the common woods, pine, ash, hickory and others. Then there are many miscellaneous uses, such as for «willow ware» furniture, chair seats, screen panels, etc., employing bamboo, osier, rattan, rushes, and splints.

6. *The Filling Fibres* are of less importance than any of the preceding, though altogether they form a large group, and include some valuable commercial forms. Their most common employment is in upholstery; wadding, from cotton; feather substitutes for filling pillows and cushions, as the silk cottons («vegetable silk»), «downs,» kapok, and fibrous material from the surfaces of leaves and stems of plants or from their capsules or fruit; mattress and furniture filling, as tow or waste of the spinning fibres (flax, etc.), unprepared basts, straw and grasses; the curled hair substitutes or Spanish moss, Crin végétal, corn husks and others. Oakum for caulking ships, the leaves of reeds or flags used for filling the seams in casks, as well as the fibres used for stiffening mortar, or the staff used in exposition buildings, are included in this category, palmetto fibre and New Zealand flax being examples. Many fibres and fibrous substances are used as packing material, but they need not be enumerated.

7. *Paper Materials.*— This group of fibres might include the whole category of fibrous substances, for there is scarcely a fibre that cannot be made into paper, the expense of preparation being the main question in determining its availability. The *Textile papers* employ the spinning fibres, in the raw state, in the form of waste, tow, jute butts, old manila rope, cotton and linen rags, etc. The *Bast papers* include such eastern fibres as Japanese paper mulberry, the tree basts, etc. The *Palm papers* are made from palmetto, yucca, and many of the tropical palms. The *Bamboo* and *Grass papers* include bamboo, esparto and other grasses, straw and maize; and lastly, the *Wood pulp papers* are made from the cellulose, chemically prepared, from spruce and other native woods.

The employment of fibre in the domestic economy must go back to the most primitive times, for among the uncivilized races of man the world over we find a dependence upon fibre plants for utensils, cordage, clothing, the building and furnishing of their huts, second only in importance to their dependence upon edible plants for food. And these plants supply hundreds of fibres which the inventive genius of the age cannot afford to use commercially. So we have two great groups of fibres, economically speaking. The «native» forms used to supply the common wants of the people of the countries where they grow, and the fibres recognized as commercial forms because they have been found best adapted to certain uses in the industrial world, and have a stated market value. Some of these have come down to us from remote ages, and the larger number long ago established their places because they were proved to be the best for the purposes for which employed, a veritable survival of the fittest. The discovery of many new fibres therefore is hardly a possibility, although we may discover new uses for well-known forms hitherto not largely employed for any purpose. But even such fibres will scarcely find a place among the fibres of first rank, but must fill the places of the better and fully recognized commercial forms as substitutes, and therefore are worth less money.

While the «native» or emergency fibres, that are known, make a list of upward of 1,500 species, the commercial fibres of value to the world would hardly reach two score in number, and those that interest the United States scarcely half that number. Altogether, counting the more unimportant forms, 25 to 30 species may be enumerated, the larger number of which figure as imported kinds, although they are imported in such small quantities, and at such irregular intervals that they cut a small figure indeed. Eight species of imported fibres would include all of the really important kinds representing the material of the great textile industries. They are: Cotton, flax, hemp, jute, manila hemp, sisal hemp, Tampico and coir or cocoanut fibre. The fibres of lesser importance are: China grass or ramie, raffia, Mauritius, Sunn, New Zealand flax, a few of the Mexican Agaves and Yuccas, Piassaba or Brazilian bass, broom root, Esparto, Crin végétal, rattan and vegetable sponge. Straw plait (and its manufactures) are also imported in considerable quantities, and there is some bamboo, kittool and palmyra.

Of native fibres, commercially employed, we use in manufacture slough grass, Spanish moss, two species of Florida palmetto, and the woods of several species of forest trees in basketry and wood pulp, besides straw and maize husks. Many native fibres are used by the North American Indian tribes, but as these are in no way commercial they are not included here. While the fibres of lesser importance are briefly referred to in this article, the references to the more important textile forms will be found alphabetically arranged under their common names, as cotton, flax, hemp, etc. Among spinning fibres of lesser importance are ramie, or China grass, Mauritius and Sunn hemps, and New Zealand flax.

Sunn hemp, *Crotalaria juncea*, is a leguminous shrub which abounds in India and Australia. Synonyms: Conkanee hemp, Indian hemp, Brown hemp and Madras hemp. A bast fibre which takes the place of jute in portions of India, though it is lighter in color and a better fibre, with a tensile strength which adapts it for cordage; used for rope making in this country, present importation less than 300 tons. In India is used for cordage, nets, sackcloth, twine and paper, 50,000 acres having been cultivated in northern provinces in a single year.

Mauritius hemp, *Furerœa gigantea*, is imported from Africa, as its name applies; thrives in the West Indies and Central and South America. Introduced into India, Ceylon and Australia. The plant is closely allied to the Agaves (such as the sisal hemp plant), the fibre being derived from the leaves, which are 4 to 7 feet long and 4 to 6 inches wide. A structural fibre, it is very similar to sisal hemp, and is used for the same purposes. The commercial supply is derived only from St. Helena and Mauritius, where the plant is cultivated. In Venezuela the native supply of this fibre is made into bags, halters, horse blankets, fish nets and cordage, and is known as *fique*.

New Zealand Flax, *Phormium tenax*. A structural fibre derived from the leaves of a liliaceous plant, resembling the flag, native to New Zealand, but found in other portions of Australia. Distributed to the Azores, St. Helena, Algiers, Southern France, and the British Isles. Thrives in California, where its leaves are used as tie material. Its many varieties produced in New Zealand yield fibre capable of manufacture into cloth of the texture of linen, satchels, table mats, sandals, sacks, rugs, and mattings, threads and twines of superior strength, cordage and cables. An inferior grade has been imported into the United States for the manufacture of binding twine. The staff used in the construction of exposition buildings is stiffened with a low grade of this fibre. At the present time 3,000 to 4,000 tons of the fibre is being imported annually, worth from $112 to $128 per ton.

Broom Root, *Epicampes macrura*. Also known as Mexican whisk and *Raiz de Zacaton*. A fibre of a bright yellow color, wavy as though crimped, stiff and harsh, measuring from 10 to 15 inches in length. Is a substitute for Venetian whisk and is used in this country for clothing and velvet brushes, scrub and other household brushes, brooms, etc. The fibre is simply the cleaned roots of a grass which abounds in a wild state in Southern Mexico. We imported last year about 450 tons, worth $85,000.

Piassaba. Two species are represented in the commercial product, the Para fibre, *Leopoldina piassaba*, also known as monkey bass, and *Attalea funifera*, both derived from Brazilian palms. An African species, *Raphia vinifera*, known as West African bass, has been imported to a slight extent in late years. The Bass fibres, from these three species, are stiff and wiry, bright chocolate in color, and are used for very stiff household brushes and brooms, and for street-sweeping machines. The fibre is obtained from the dilated bases of the leaf stalks, which separate into a long coarse fringe; this is collected by the natives, sorted and tied in bundles, and baled for market.

Palmyra, *Borassus flabellifer*, is a similar palm fibre from Ceylon, a little finer, redder in color, and about two feet long. It is obtained from the base of the petioles or leafstalks. It is also found in India, and tropical West Africa; used as a brush material; first came into notice in 1891. Trade name, Cassine.

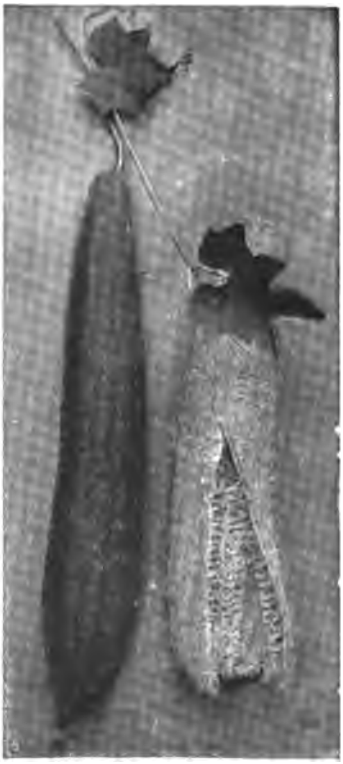
Kittool, a similar fibre, derived from the jaggery palm, *Caryata urens*. Structural fibre; brownish black, the filaments straight, smooth and glossy, showing considerable tenacity, and capable of twisting as the fibre is elastic. Common in India and Ceylon. We have imported as high as $16,000 worth of kittool in a single year for the manufacture of brushes for brewers use. The fibre is taken from the bases of the leafstalks. For further information concerning this and other fibres briefly mentioned see 'A Descriptive Catalogue of Useful Fibre Plants of the World,' and 'Dictionary of the Economic Products of India.'

Palmetto fibre. Two species of the Florida palmetto supply commercial brush fibre. The fibre from the saw palmetto, *Serrenoa serrulata*, is derived from the macerated stems of the leaves, which are sometimes five feet long. It is a harsh, brittle fibre, white in color when well prepared, and makes a very cheap substitute for bristle brushes. Also used as a substitute for cow's hair in plaster, while the shredded leaves have been employed as mattress filling. The cabbage palmetto, *Sabal palmetto*, yields fibre reddish in color, somewhat resembling cocoa fibre. It is derived from the «boots» or spathes of the leaf-stems which surround the bud or «cabbage,» and in securing the bud the tree is killed. After a process of steaming and crushing the boots, the mass is combed and the softer, tangled fibre extracted, leaving the stiff, straight, coarse brush material, which represents about 25 per cent of the original fibrous substance of a boot. This product goes into cheap brushes for household use.

Crin végétal, or African fibre, *Chamærops humilis*, is derived from an Algerian species of palm similar to the Florida palmetto. The commercial product is produced by shredding the leaves, and as imported resembles twisted ropes of hay. It comes in two colors, a pale greenish (called white) and in black. The twisting crinkles the fibre so that when again opened it retains the «curl,» and in this form is employed as a substitute for curled hair in the filling of mattresses. As the fibre is quite elastic it is a valuable upholstery material.

Spanish moss, *Tillandsia usenoides*. This is a native filling fibre. The plant is parasitic on trees and is seen hanging in dense gray masses

FIBRE PLANTS—II.



1. California Hemp.
2. Sunn Hemp.
3. Louisiana Jute.
4. China Grass, or Ramie.
5. Cabbage Palmetto.
6. Sponge Cucumber.

in many portions of tropical and sub-tropical America. The fibre is the entire plant in mass, after the gray epidermis has been removed. It is black in color, and resembles curled hair, for which it is a tolerable substitute. Manufactured chiefly in Charleston, S. C., and in New Orleans, La.

Pulu, an Hawaiian surface fibre, useful for stuffing pillows, etc., is simply the hairs which grow at the bases of the leafstalks of several species of *Cibotium,* a genus of tree ferns. It is regularly exported from Honolulu to San Francisco. The substance is yellowish in color, and resembles wool. The golden moss of the Chinese is a similar fibre.

Raffia, *Raphia ruffia,* is a palm fibre, imported from Madagascar. The commercial product comes in the form of narrow ribbons of fibrous material, derived from the cuticle of the leaves of an African palm, taken before they are fully expanded, by peeling the leaf on both sides. Imported as a tie material for nurserymen; used also for the manufacture and trimming of ladies' hats; has recently come into extensive use in connection with splints of rattan, for hand-made fancy baskets, the art now being taught in all of our larger cities. Takes dye readily, and can be purchased in several colors.

Another millinery trimming fibre is the Cuba bast, *Hibiscus elatus,* which comes in the form of thin ribbons of bast, which are the separated layers of the inner bark of a large tree. These ribbons or strips are plaited into ladies' hats, either in the flat, or twisted forms, the white color and satiny sheen making the product peculiarly adaptable to the purpose. In this connection may be mentioned the poplar and willow shavings, or thin strips of wood known as «chip,» and imported from Germany for the same purposes.

Straw is imported from Italy, Germany and Japan, wrought into «straw plait» or «braids» for the manufacture of hats, fancy baskets, etc. The Tuscan braids are the finest and are produced from wheat straw specially grown, although rye straw is also employed in Italy. The braids from China and Japan are from rice and barley straw, while the Bohemian straw plait is from wheat. Two native American grasses, *Poa pratensis,* and *Sporobolus indicus,* have also, in past time, been employed for the same purpose.

The Eastern or Oriental floor mattings imported into this country are made from several species of rushes or sedges. The Chinese and Korean are produced from *Cyperus tegetiformis;* the Japanese from *Cyperus unitans,* and *Juncus effusus;* the Indian from *C. corymbosus, C. esculentus,* and *C. tegetum.* Other species are also employed, though the above are the most common. The Japanese mat rush industry is very extensive, over $400,000 worth of mats having been exported in a single year. *Cyperus unitans* is the *Shichito-i* of Japan, from which the cheaper, coarser mats, for the common people, are produced, while *Juncus effusus* is the *Bingo-i,* or form employed for the mats of the higher classes, both being cultivated. The technique of mat making is practically the same in China, Japan, India, and Ceylon. The culms are either used entire or split into two or more parts, and woven upon a warp of thread, these often stretched upon the floor, for much of this material is woven by laborious hand methods.

In the United States a new form of floor matting has recently come into vogue, produced from slough grass, *Carex filiformis,* also known as the slender sedge. The material grows wild over vast areas of the river bottoms of the Mississippi, and streams tributary. It is cut in July or August, dried, and by means of special machinery, worked into a continuous strand, bound with thread or fine twine. It is afterward woven into mattings, the warp being cotton yarns in high colors. The grass twine as prepared for weaving is also used as binder twine for grain.

The sponge cucumber or snake gourd, *Luffa cylindrica,* is imported from Japan in considerable quantities as a substitute for the bath sponge. The commercial article is the entire gourd with the epidermis and seeds removed, presenting the appearance of a network of straw-colored fibre. It is extensively cultivated in Japan, for export. Grows in the southern United States, but has never been produced commercially, though used for bath sponge, flesh brush, dish cloths, and even for fancy baskets, and bonnet crowns.

Among high-grade fibres that have been the subject of experiment in the United States, but which are not produced commercially may be mentioned pineapple fibre, from *Ananasa sativa.* Fibre extracted in Florida was found to be fine, soft, flexible and very resistant. The filaments yield to treatment in the alkaline bath and are easily subdivided, producing an admirable spinning fibre. In the Philippines, the fibre is used to some extent in the fabric known as piña cloth which is becoming known in Europe and America, and may in time become of commercial importance. See Special Report No. 5, Office of Fibre Investigations, Department of Agriculture, Washington, and Bulletin No. 4, Philippine Bureau of Agriculture, Manila, for further information regarding pineapple fibre.

Another valuable but unemployed spinning fibre that might be produced in the United States is the bowstring hemp, *Sansevieriasps.* The plant grows to perfection in southern Florida, and yields a fibre which combines all the good qualities of length, strength, fineness, color and divisibility, which adapts it for employment in the manufacture of fine threads, and even fabrics. The lack of machinery to properly extract the fibre, as well as the fibre of pineapple, is the chief drawback to the establishment of two new industries. There are eight or more species of bowstring hemps, all of which are considered valuable for fibre. The Florida species is *S. longiflora.*

Mexico abounds in fibre plants, many species of Agave and Yucca not recognized as standard commercial forms being employed for rope, coarse bags and mattings. A little of this fibre finds its way to the United States for employment in coarse twine manufacture, though not in appreciable quantities at present. Palma Istle, and Pita Sylvestre are local trade names applied to a harsh, low-grade fibre produced from two species of Yucca. Pita is a Mexican name applied to several Agave fibres, and to some allied species, though pita is generally understood to mean the fibre of *Agave americana.* There are several species of Agave, known in Mexico as Mescals, which produce fibre of good strength, which might be employed in cheaper grades of cordage.

The imports of commercial fibres (raw) for the year ending 30 June 1910 were valued at over $32,000,000, though this sum should not be taken as alone representing the consumption of fibre manufactures in the United States, for we import vast quantities in the manufactured form. As an illustration, the importation of flax manufactures in a single year has been seven times greater than the imports of raw and hackled flax for the same period. Probably the ratio of raw to manufactured, as shown by the tables of importation, would stand about one to four, for all classes of fibre, which with the native kinds, not considering paper materials, might give a grand total of upwards of $125,000,000, as the value of the raw and manufactured for a single year. See COIR; CORDAGE; CORDAGE INDUSTRIES; COTTON; FLAX; HEMP; ISTLE; JUTE; MANILA HEMP; MATTING; RAMIE; SISAL HEMP.

CHARLES RICHARDS DODGE,
Commercial Fibre Expert, Washington, D. C.

Fibre Plants. See ESPARTO; FIBRE; FLAX; JUTE; RAMIE; SISAL; etc.

Fibrin, fī'brin, the chief substance formed in the coagulation of the blood-plasma. It may also be found in coagulation of lymph and in other fluids that contain fibrinogen. It is usually taken from the blood by whipping it with a bunch of wire or glass rods as it falls into a vessel, before it has had time to coagulate into a solid mass. When obtained from fresh blood in this way, fibrin is a stringy substance while wet, and dries to a glue-like mass. It is a proteid, and consists of at least two globulins, one coagulating at 50° C., the other at 56° C. Under the action of pepsin these are converted into acid albumin, proteoses, and peptones. Blood yields from .2 to 4 per cent of its weight of dry fibrin. See BLOOD; FIBRINOGEN.

Fibrinogen, fī'bri-nō-jen, a substance found in the plasma of the blood, and which brings about spontaneous coagulation of that fluid. It is also found in the lymph and in a number of other fluids of the body. Fibrinogen may be precipitated from the blood-plasma by the addition of magnesium sulphate or sodium chloride. It is soluble in dilute alkalies, and is precipitated from solutions in these weak alkalies by acetic acid. Fibrinogen is probably not a simple substance, but a mixture existing in loose combination of at least three substances. These as given by Schäfer are fibrinogen proper, coagulating at 56° C., a globulin, described by Hammarsten, and termed fibrino-globulin, and a nucleoproteid. The relationships of fibrinogen and fibrin and the blood-ferment are expressed by Schäfer as follows: «(1) That the coagulation of blood, that is, the transformation of fibrinogen into fibrin, requires for its consummation the interaction of a nucleoproteid (prothrombin) and soluble lime salts, and the consequent production of a ferment (thrombin); (2) that either nucleoproteid is not present in appreciable amount in the plasma of circulating blood, or that the interaction in question is prevented from occurring within the blood vessels by some means at present not understood; (3) that the nucleoproteid (prothrombin) appears, and the interaction occurs, as soon as the blood is drawn and is allowed to come into contact with a foreign surface, the source of the nucleoproteid being in all probability mainly the leucocytes (and blood-platelets?); (4) that, under certain circumstances and conditions, either the nucleoproteid does not appear in the plasma of drawn blood, or it appears, but the interaction between it and the lime salts is prevented or delayed; (5) that the nucleoproteid (prothrombin) appears in the plasma of circulating blood under certain conditions, being in all probability shed from the red blood-corpuscles; and that when shed out under these conditions from the corpuscles, or when artificially injected into the vessels, it tends to interact with the lime-salts of the plasma and to form fibrin ferment (thrombin), intravascular coagulation being the result; (6) that, under other conditions, either the shedding out of nucleoproteid from the corpuscles, or its interaction with the lime-salts of the plasma, may be altogether prevented and the blood rendered incoagulable, unless nucleoproteid be artificially added, or unless a modification of the conditions is introduced which will permit of the interaction of the nucleoproteid with lime to form ferment; (7) that the nucleoproteid (prothrombin) is incompetent, in the entire absence of lime-salts to promote the transformation of fibrinogen into fibrin; but, as a result of its interaction with lime-salts, it becomes transformed into a ferment (thrombin), which, under suitable conditions of temperature and the like, produces fibrin; (8) that either the place of nucleoproteid in coagulation may be taken by certain albumoses, such as those found in snake-venom, and by certain artificial colloidal substances, such as those prepared by Grimaux, or that such substances may act by setting free nucleoproteid from the leucocytes and other elements in the blood or from the cells of the blood vessels, and thus indirectly promote coagulation.» See BLOOD; COAGULATION; FIBRIN.

Fibro Cartilage. See CARTILAGE.

Fibrolite. See SILLIMANITE.

Fibroma. See TUMOR.

Fibropsammoma. See TUMOR.

Fibrosarcoma. See TUMOR.

Fibula. See ANATOMY; OSTEOLOGY.

Fichel, Eugène, ė-zhen fē-shel, French painter: b. Paris 30 Aug. 1826; d. there 1 Feb. 1895. He was a pupil of Delaroche, but painted very much more under the inspiration of Meissonier, whose exquisite handling is recalled in numerous small canvases of his which by their refined technique and vivid action recall the characteristic intensity and directness of composition which belong to the painter of 'Friedland.' The principal works of this painter are of a high order of genre, and include, 'The Violin Player'; 'A Festival in the Year 1776'; 'The Capture of a Spy'; 'The Wandering Singers'; and the following historic pictures, which have the freedom and imagination of pure genre: 'The Night of August 24, 1572'; 'Founding of the French Academy.'

Fichte, Immanuel Hermann von, im-mā'-noo-āl hăr'măn fon fiн'tĕ, German philosopher: b. Jena 18 July 1796; d. Stuttgart 8 Aug. 1879. He was a son of Johann Fichte (q.v.), and in his philosophy was a mystic theist. Among his writings are: 'Speculative Theology' (1847); 'System of Ethics' (1850); and 'The

JOHANN GOTTLIEB FICHTE.

Soul Question: A Philosophic Confession' (1859).

Fichte, Johann Gottlieb, yō'hän gȯt'lēb, German philosopher: b. Rammenau, near Bischofswerda, Upper Lusatia, 19 May 1762; d. Berlin 27 Jan. 1814. He studied at Jena, Leipsic, and Wittenberg, passed several years as a private tutor in Switzerland and Prussia, and in Königsberg enjoyed the society of Kant. His 'Versuch einer Kritik aller Offenbarung' (Essay toward a Criticism of all Revelation) (1792) attracted general attention, and procured him the professorship of philosophy in Jena in 1793. In 1800 he was one of the most prominent professors of that university during its most brilliant period. Here he published, under the name of 'Wissenschaftslehre' (Theory of Science), a philosophical system, founded at first on the system of Kant, from which, however, he gradually deviated. On account of an article, 'Ueber den Grund unseres Glaubens an eine Göttliche Weltregierung' (On the Reasons of our Belief in a Divine Government of the Universe), which appeared in his 'Philosophisches Journal' in 1798, he fell under the suspicion of atheistical views. This gave rise to an inquiry, and Fichte resigned his professorship. In 1805 he was appointed professor of philosophy at Erlangen, and in 1810, on the establishment of the university of Berlin, was appointed professor of philosophy there. Fichte's philosophy, though there are two distinct periods to be distinguished in it, is a consistent idealism, representing all that the individual perceives without himself, or, rather, all that is distinguished from the individual, the *ego*, as a creation of this *I* or *ego*. His 'Ueber den Begriff der Wissenschaftslehre' (1794); 'Die Wissenschaftslehre in ihrem allgemeinen Umrisse' (1810); and the 'Anweisung zum seligen Leben' (1806) contain the substance of his teaching. His practical is purer than his theoretical system. His idealism led him to represent the life of the mind as the only real life, and everything else as a mere delusion, and to believe in an almost absolute omnipotence of the will. To excite his pupils to the highest virtue and self-denial was his constant aim as a teacher, and his influence was great, not merely through his power of expression and the originality of his ideas, but through the conviction with which he inspired his hearers of his full belief in, and entire devotion to, his principles. His heart was open to every noble and good feeling. Unshaken integrity, constant friendship, devoted love of what he conceived to be true and good, were his characteristic traits. When Germany was suffering under the wounds of war he, like his countrymen in general, considered Napoleon as the source of the whole distress of his country, and in his 'Reden an die deutsche Nation' (Addresses to the German Nation), published in Berlin while it was still in the hands of the French, he boldly called upon his countrymen to rise and throw off the foreign yoke. The more popular works of Fichte, known in English through the translations of W. Smith, consist of: 'The Vocation of the Scholar'; 'The Nature of the Scholar'; 'The Destination of Man'; 'The Characteristics of the Present Age'; and 'The Way toward the Blessed Life.' His complete works were edited by his son in 8 volumes (1845-6).

Fichtelgebirge, fiʜ'tel-gĕ-bĕr'gĕ, a mountain range, chiefly situated in the northeast of Bavaria, once covered with pines (*Fichte*, «pine»), and constituting a watershed between the head-feeders of the Elbe, the Rhine, and the Danube. The average elevation of the peaks ranges from 2,700 to 3,200 feet. The highest summits are Schneeberg (3,461 feet) and Ochsenkopf (3,334). In their northern extremities the Fichtelgebirge are connected by intermediate chains, on the one hand with the Erzgebirge, and on the other with the Thuringian Forest. They are composed principally of granite and primitive crystalline slates, with bands and intrusions of gneiss, micaceous slates, basalt, and some strata of the Tertiary Age (*Oligocän*). Snow lies on the summits as a rule from October to May. The chief industries are those connected with mining iron ore, quarrying of marble, manufacturing glass, and getting of timber from the forests. Of recent years the Fichtelgebirge have come much into vogue with tourists. Consult: Ruchdeschel, 'Hand-book of Bavaria.'

Ficino, Marsilio, mar-sē'lē-ō fē-chē'nō, Italian philosopher of the Platonic school: b. Florence 19 Oct. 1433; d. Careggi 1 Oct. 1499. His early display of talent attracted the notice of Cosmo de' Medici, who induced him to translate the writings of Plato and of the Neo-Platonists into Latin; he afterward employed him to aid in establishing a Platonic Academy (about 1460). Ficino engaged in this plan the more readily, because he viewed the Platonic philosophy as a sort of preliminary to, and confirmation of, the Christian faith. In his accounts of this philosophy he did not always make an accurate distinction between Plato and the New Platonists, as appears from his 'Theologia Platonica; de Immortalitate Animorum ac æterna Felicitate,' in which he particularly defends the immortality of the soul against the Aristotelians of his age. Mystic and fanciful views are interwoven with this defense; astrological doctrines, for example, which he afterward rejected. At the age of 40 he was presented by Lorenzo de' Medici with the rectorship of two Florentine churches, and a canonry in the cathedral. His Latin works were first published complete at Basel (1561).

Fick, Adolf, ä dȯlf fik, German physiologist: b. Cassel 3 Sept. 1829; d. 1901. He was professor at Würzburg and published: 'Die medizinische Physik'; 'Kompendium der Physiologie.'

Fick, August, ow'goost, German philologist: b. Petershagen, Westphalia, 5 May 1833. He studied at Göttingen 1852-7, becoming professor of comparative philology there 1876, and occupying the same chair at Breslau 1888. He is an authority on the primitive Indo-Germanic languages and Greek philology. Among his works are: 'Die ehemalige Spracheinheit der Indogermanen Europas' (1873); 'Vergleichendes Wörterbuch der Indogermanischen Sprachen,' his masterpiece (1874-6); 'Die griechischen Personennamen' (1877); and 'Die homerische Ilias nach ihrer Entstehung betrachtet und in der ursprünglichen Sprachform wiederhergestellt' (1885).

Fiction, in law, is an assumption made for the purposes of justice, though the same fact could not be proved, and may be literally untrue. There are many fictions in the civil law, and a fiction in law is said by civilians to be the assumption of an untruth for a truth, in a thing possible to have been done, but which was not done. The declaring that a note or bond made in a foreign country was made in the county where a suit is commenced upon it, is an instance of a very common fiction, adopted on the ground that suits can be brought in the county only on causes of action existing within its limits; and so the practice has been introduced of declaring that the contract on which an action is brought was made in the county, though the fact seems to be entirely immaterial; for transitory actions follow the person, and it is only of such that the fiction is admitted. The fictitious characters of John Doe and Richard Roe for the purposes of various actions are well known. It is a rule that a fiction of law shall work no wrong; and the fictions in use generally come within this rule.

Fiction in America. While the art of fiction writing in America is scarcely more than 100 years old, its genesis may be traced far back into the records of literature. Prior to 1798, when Charles Brockden Brown laid the foundations of his fame with the writing and the publication of ‹Wieland,› the art of writing fiction in this country was scarcely known. Novels were published, imported and read, but they were largely the work of English writers or translations from foreign languages. With the advent of Charles Brockden Brown, however, imaginative literature began to gain a foothold, and the literary man to secure a standing in the professional world. Brown has usually been styled the precursor of the American novelist and the founder of American fiction. There had been isolated attempts at fiction writing before his day, but the results were meagre both in quantity and in quality. The list is virtually complete with ‹The Pretty Story,› by Francis Hopkinson; ‹The Power of Sympathy,› by Mrs. Morton; ‹The Foresters,› by Jeremy Belknap; ‹Modern Chivalry,› by Hugh Henry Brackenridge; ‹The Algerine Captive,› by Royall Tyler (who also holds position as one of the early American dramatists); ‹History of a Corporation of Servants,› a satirical romance, by John Witherspoon; ‹Female Quixotism: the Romantic Opinions and Extravagant Adventures of Dorcasina Sheldon,› by Mrs. Tabitha Tenny; and ‹The Coquette,› by Mrs. Hannah Foster. Of these early novels ‹The Foresters,› by Jeremy Belknap, was the most important. The poet Bryant describes it as «a work which sought to embellish our literature with the charms of wit and humor.» Susannah Rowson's ‹Charlotte Temple› can scarcely be accounted an American novel, for it was first published in England and its author was of English birth and residence, although she lived for a considerable length of time in this country.

It is a somewhat curious fact that Charles Brockden Brown (q.v.) reveals in his work little of the American character, the American temperament, and the American people. On the other hand, he shows in his own trend of thought and choice of subjects that longing for the mysterious in life which was later to find its fullest expression in Poe and in Hawthorne. He was a student of the mystic and his novels presage the beginnings of modern psychical research. His ‹Wieland,› ‹Ormond,› ‹Arthur Mervyn,› ‹Edgar Huntley,› ‹Clara Howard,› and ‹Jane Talbot› were varied expositions of experiences now classed exclusively as psychical phenomena, although by him they were treated merely from the curious and spiritual points of view. His life ended 22 Feb. 1810, before he had reached the age of 40, and so slow was the growing interest in American fiction that little advancement had been made prior to his death. With the advent of Washington Irving (q.v.) and James Fenimore Cooper (q.v.), the imaginative literature of America proved the force and might of its English heritage. As early as 1809 appeared Irving's ‹Knickerbocker History of New York,› which may fairly be classed as a romance if not as a novel. It was Irving's second published work, his first being the volume of reprinted miscellany called ‹Salmagundi,› which had appeared the year before. Surrounded by a group of brilliant men, Irving settled down to a life of literary leisure, and in time ‹The Sketch Book,› ‹Bracebridge Hall,› and ‹Tales of a Traveler› took their place in literature. James Kirke Paulding (q.v.), his friend and comrade, shared the honors of the ‹Salmagundi› essays with Irving, and in 1813 his ‹Diverting History of John Bull and Brother Jonathan› led the way to a continuous flow of volumes in fiction, poetry and essay which did not cease until his death 6 April 1860. ‹The Dutchman's Fireside› was his most important novel.

It was not, however, until 1821-2 that the novel of American life written by a typical American author began its vogue. In that year, with the publication of ‹The Spy,› the fame of James Fenimore Cooper had its beginning. He had already written ‹Precaution› (1820); but that novel was a romance of English society life, and does not form a part of Cooper's most characteristic work. After ‹The Spy,› came ‹The Pioneers›; ‹The Pilot›; ‹Lionel Lincoln›; ‹The Last of the Mohicans›; ‹The Bravo›; ‹The Prairie›; and ‹The Red Rover›; and for 30 years, until his death 14 Sept. 1851, Cooper was the pre-eminent American novelist who was equally expert in chronicling the life of the Indians and in writing the narratives of perilous adventures by sea. During this period the American novel and the American novelist proved that their position was secure. John Pendleton Kennedy, with his ‹Swallow Barn›; ‹Rob of the Bowl›; and ‹Horseshoe Robinson›; Dr. Robert Montgomery Bird, with his ‹Nick of the Woods›; William Ware with his ‹Zenobia› and ‹Julian›; Herman Melville with his ‹Typee›; ‹Omoo›; and other remarkable sea stories; William Gilmore Simms, next to Cooper the most voluminous American novelist, with his many revolutionary and border romances; Charles Fenno Hoffman with his many romances of historical and legendary lore; Mrs. Caroline M. Sedgwick with her ‹Redwood›; ‹Hope Leslie›; and ‹The Linwoods›; are among the few names of novel writers who flourished during the period following the advent of James Fenimore Cooper. One name alone — the greatest of them all — has been omitted, but Edgar Allan Poe's (q.v.) work covered so many branches of literature and the man himself is so absolutely one of the world's great writers that he needs no more than passing mention in this review of American fiction. As a master of the short story and as a writer of some of the finest tales known to any language — 'The Murders in the Rue Morgue'; 'The Tell Tale Heart'; 'The Fall of the House of Usher' — Poe's rank is secure. His achievements in other fields are fully outlined in the article in this work devoted especially to him.

Fittingly after Poe comes the name of Nathaniel Hawthorne (q.v.), for it was in 1850, the year following Poe's death, that 'The Scarlet Letter' was published. This was the first if not the only great American novel. There had been nothing like it in American literature, and scarcely anything like it in the world's literature. At the time of its publication, Hawthorne was 45 years of age, he had been writing since boyhood, and his name had been known for 15 years as that of a novelist and short-story writer of peculiar style, extraordinary gifts and sombre tendencies. 'The Scarlet Letter,' however, immediately showed the unique and unapproachable power of his genius, and with 'The House of the Seven Gables' (1851), 'The Blithedale Romance' (1852), and 'The Marble Faun' (1860), which followed, it placed Hawthorne among the greatest of the world's great fiction-writers. During this era of Hawthorne's progress the art of writing fiction was growing apace. In 1852, 'Uncle Tom's Cabin' achieved three things: it made Mrs. Harriet Beecher Stowe (q.v.) a famous woman, it aroused an enormous public sentiment against slavery, and it created a desire for novel reading among hundreds of thousands of people who could not before have been persuaded even to look into a work of fiction. Mrs. Stowe, as was to be expected, never repeated the triumphant success of 'Uncle Tom's Cabin,' although during her long life she wrote many novels. Nathaniel P. Willis, at this time at the height of his unique fame, was turning out volume after volume of fantastic work in poetry, fiction, and essays. George William Curtis' long and versatile career covered both the ante-bellum and the post-bellum periods, his 'Prue and I,' his 'Potiphar Papers,' and his 'Trumps' being simply imaginative wanderings into a form of fiction and social satire somewhat apart from his general literary interests. Susan Warner had in the very year of the publication of 'The Scarlet Letter' gained for herself an extraordinary popularity with 'The Wide, Wide World,' a story still in extensive demand at public libraries, and Mrs. Mary Jane Holmes, Mrs. E. D. E. N. Southworth and Mrs. Ann Sophia Stephens were beginning that long series of sensational novels which, while not a part of literature, deserve record because of the place they hold in the hearts of the reading public and because they have helped to create a reading habit which has led to better things. At this time, too, there appeared the first American historical novelist, Jeremiah Clemens, of Alabama, who wrote and published 'The Rivals' (1859), and other novels. To this period also belongs Rev. J. H. Ingraham, who from writing many lurid, sensational novels, turned in his latter days to sacred history and evolved 'The Prince of the House of David.' In the sixties, Theodore Winthrop, a descendant of an historic family, a brave young soldier and a gifted writer, began a career in letters which was untimely cut short by his death in the Civil War. He was only 33 years of age, but his 'Cecil Dreeme,' his 'John Brent,' and his other stories published after his death gave evidence of the power he might have become in American literature.

As early as 1839, the poet Longfellow (q.v.), returning from a European trip which had filled his receptive brain with Old World fancies and mediæval legends, wrote his 'Hyperion,' a romantic tale, the heroine of which was Miss Frances Appleton, of Boston, whom he married in 1843. Ten years later Longfellow again turned his thoughts to prose romance, producing in 'Kavanagh' a story remarkable more for its psychological elements than for any of those active phases of thought which should characterize a notable work of fiction. His success was so slight, however, and he was so keenly criticised for his venturesomeness in attempting to leap the bounds of his own field of poetry into an untraveled highway, that thereafter he was content to express his romantic feelings wholly in verse. Among the other American poets whose versatility led them to the writing of novels, Oliver Wendell Holmes (q.v.) is the best known. His famous 'Breakfast Table' series is a compound of romance, essay and poesy, and its four volumes of genial miscellany and philosophy will doubtless live long after his two novels — 'Elsie Venner' (1861), and 'The Guardian Angel' (1867) — are forgotten. It was also in the same decade that Bayard Taylor (q.v.) added his first work of fiction to his rapidly lengthening list of works in almost every branch of literature. His novels comprise: 'Hannah Thurston,' 'John Godfrey's Fortunes,' 'The Story of Kennett,' and 'Joseph and His Friend,' all published between 1863 and 1870. Contemporary with Bayard Taylor was J. G. Holland, who wrote 'Seven Oaks,' and John Townsend Trowbridge, whose 'Neighbor Jackwood,' 'Cudjo's Cave,' and 'Coupon Bonds' are prominent in a long series of works largely made up of poetry and juvenile fiction. Trowbridge stands at the head of a long line of writers who have devoted their energies to the production of books for the young, his position among writers for boys being paralleled by Louisa May Alcott with her 'Little Women,' 'Little Men,' and other clever stories for girls. Other voluminous authors of juvenile fiction during the generation following 1860, when the creation of a special form of literature for boys and girls was at its height, were William T. Adams (Oliver Optic), Horatio Alger, Jr., Elijah Kellogg, and Harry Castlemon. They all of them obviously tried to instruct as well as to amuse their youthful readers, a double purpose attained with less success by that pioneer of juvenile authors, Jacob Abbott, whose chief claim upon posterity he owes to the famous 'Rollo' books which have been burlesqued and parodied ever since their career began about the year 1840.

The modern epoch of American fiction begins with the close of the Civil War, and henceforth romance writers and novelists multiplied rapidly. The post-Civil War writers, those whose reputations were established prior to 1880 and after 1865, are meagre in numbers compared with those who became popular during the last 20 years of the 19th century. Of the writers who arose in the latter period, four names naturally come to mind — William Dean Howells, Thomas Bailey Aldrich, Bret Harte and Henry James the younger. Their names are here given in the chronological order of their appearance before the public. Mr. Howells, who through his facility as a writer and his ability to adapt himself to many varied forms of composition — the novel, the essay, the poem and the play — has practically become the most distinguished, if not the greatest American man of letters, began his apprenticeship in the exacting field of journalism. After the publication of ‘A Chance Acquaintance’ (1874), he turned his attention to the making of realistic novels, and it was not long before he was accepted as the exponent of a distinctive school of American fiction whose chief claim is its dictum that the commonplace and generally ignored facts of life shall form the true province of the novelist. His books written in pursuance of this method followed one another in rapid succession, the most notable of them being: ‘A Foregone Conclusion,’ ‘A Modern Instance,’ ‘The Rise of Silas Lapham,’ ‘The Minister's Charge,’ ‘April Hopes,’ and ‘A Hazard of New Fortunes.’ Although Mr. Howells has been extraordinarily active in all phases of literary work, it is distinctly as a “realistic” novelist that he is now known and will be remembered by posterity. As Mr. Howells is the exploiter of a theory in fiction, so Bret Harte was the discoverer and creator for literary purposes of an undiscovered country, the California of 1849. He was pre-eminently a short story writer, and it needs only a knowledge of ‘The Luck of Roaring Camp,’ ‘Tennessee's Pardner,’ of ‘M'liss’ and a hundred more of his tales to realize how thoroughly his art was restricted and how its very perfection made it impossible for him to succeed with ‘Gabriel Conroy,’ and the other long novels he attempted. Thomas Bailey Aldrich, singularly enough, became a novel writer through the vogue of a juvenile tale, ‘The Story of a Bad Boy,’ published in 1869, after serial appearance in a monthly magazine. Mr. Aldrich has published ‘Prudence Palfrey,’ ‘The Stillwater Tragedy,’ and many volumes of short stories. Although Henry James, Jr., has resided in England for many years, he still holds his position as an American author of unique style and genius. He makes no bid for popularity, being content to express his own individuality and thought, and to expound his philosophic views of literature and life to a public which is able to understand and appreciate such novels as ‘The American,’ ‘Daisy Miller,’ ‘The Bostonians,’ and ‘The Tragic Muse.’ Although Edward Everett Hale and Thomas Wentworth Higginson antedate the foregoing writers almost by a score of years, they practically belong to the same literary epoch, for it is since the Civil War that they have contributed liberally to the supply of American fiction, mainly in the form of short stories. For 20 years or more E. P. Roe's name was held high in the esteem of a large class of fiction readers who delighted in the placid commonplaces of ‘The Opening of a Chestnut Burr,’ and its companion tales, but his repute was ephemeral and he is now almost forgotten. With the mention of Frank R. Stockton, who wrote ‘The Lady or the Tiger,’ Edward Eggleston, George W. Cable, Elizabeth Stuart Phelps, Joel Chandler Harris, Francis Marion Crawford, Albion W. Tourgee, Lew Wallace (whose ‘Ben Hur’ became immediately popular upon its publication in 1881), Hamlin Garland, Harold Frederic, and Sarah Orne Jewett, the story of American fiction is brought down to a time when the beginnings of present-day reputations may be remembered by the youngest reader. Of Mark Twain and his work much could be said, for his later years were productive of famous novels: ‘The Prince and the Pauper,’ ‘Jeanne D'Arc,’ ‘Pud'nhead Wilson,’ ‘Tom Sawyer,’ and his other classics of American humor rank him among the great literary figures of the present era.

The leading note of contemporary American fiction is sounded from the West. With the exception of Howells, Wallace, Mark Twain, and one or two others, the first 80 years of our fiction is concerned wholly with writers native to the eastern and the southern portions of the United States. But toward the close of the 19th century, the western country began to develop writers of fiction. About the same time Mary E. Wilkins arose in the East, and James Lane Allen in the South, and each have gained no little reputation for the skilful manner in which they have set down the mingled characteristics of their own localities. Miss Wilkins has brought the short story into high estate through her picturesque handling of commonplace incidents and through her delineations of New England character, while Mr. Allen has been especially adept in his analysis of the human soul. The numerous novels written by Julian Hawthorne show the influence of heredity, and it is altogether likely that the son of Nathaniel Hawthorne might have made a higher position for himself in his chosen profession had he not been obliged to remain in the shadow of his father's great reputation. Frances Hodgson Burnett, although of English birth may be ranked through her long residence in this country as an American author. ‘That Lass o' Lowrie's,’ ‘A Lady of Quality,’ and the juvenile ‘Little Lord Fauntleroy,’ are evidence that she is not lacking at least in exceptional versatility. In ‘The Prophet of the Great Smoky Mountains,’ ‘In the Clouds,’ and other volumes of lengthy novels and short stories, Mary N. Murfree (Charles Egbert Craddock) has made herself the historian of the Tennessee mountain region. In 1888 Margaret Deland's ‘John Ward, Preacher,’ attracted wide attention to a writer, the excellence of whose work has ever since been kept at high standard. Robert Grant, with his ‘Confessions of a Frivolous Girl,’ and ‘Unleavened Bread,’ may be called the novelist of the social East, and Henry Harland, although his long residence in England has caused him to lose something of his American identity, is well known by such fantastic stories as ‘The Cardinal's Snuff Box,’ and ‘The Lady Paramount.’ Paul Leicester Ford, historian and bibliographer, wrote ‘The Honorable Peter Stirling,’ an artistic novel of political life notable from every point of view, and ‘Janice Meredith,’ a popular flamboyant novel.

The modern extravagant vogue of the historical novel has been stimulated and fostered especially by Mary Johnston and Winston Churchill. In the late nineties Booth Tarkington achieved a veritable *tour de force* with a remarkable little story called ‘Monsieur Beaucaire.’ The story of American fiction may fittingly be brought to a close with the name of Edith Wharton, whose genius as expressed in

'The Touchstone,' 'The Greater Inclination,' and 'The Valley of Decision,' gives her unquestioned place among modern novelists.

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Fiddle-beetle. See FUNGUS-EATERS.

Fiddler-crab, the American name for the small and active crabs of the genus *Gelasimus,* called "calling crabs" by the English, who say they are waving the enormously developed front claw on the right side in beckoning, while the Americans imagine them to be fiddling. This great claw is brightly colored, and is used by the males not only as a weapon, but to be displayed as an attraction before the females. These crabs throng in thousands in salt-marshes near high-water mark, where they dig burrows.

Fides, fī'dēz, the Roman goddess of faith and honesty. Numa was the first who paid her divine honors.

Fiduciary, a law term signifying a relation of trust and confidence, generally by one acting as trustee, executor or administrator, or a director of a corporation.

Field, MRS. **Caroline Leslie,** American author: b. Milton, Mass., 10 Nov. 1853. She is a daughter of Mrs. A. D. T. Whitney (q.v.), and has published: 'High Lights,' a novel (1885); 'The Unseen King, and Other Verses' (1887); 'Nannie's Happy Childhood' (1889); etc.

Field, Cyrus West, American merchant: b. Stockbridge, Mass., 30 Nov. 1819; d. New York 12 July 1892. He was the son of Rev. D. D. Field (q.v.). He early attained an important position in the mercantile world, and began to interest himself in ocean telegraphy. Having obtained a charter giving him the exclusive right for 50 years of landing ocean telegraphs on the coast of Newfoundland, he organized an Atlantic telegraph company for the purpose of laying telegraph cables across the ocean. Attempts to lay cables were made in 1857 and 1858, but without permanent success, though ships had been provided by the English and the American governments. The scheme was interrupted by the outbreak of the American Civil War, but a renewed attempt to lay a cable was made in 1865, the Great Eastern now being engaged in the work. About 1,200 miles had been laid by that vessel when the cable parted; but at last, in 1866, a cable was successfully laid by the Great Eastern, and the broken one recovered and completed. Mr. Field subsequently took an active part in establishing telegraphic communication with the West Indies, South America, etc., and was connected with various important enterprises.

Field, David Dudley, American Congregational clergyman: b. East Guilford (now Madison), Conn., 20 May 1781; d. Stockbridge, Mass., 15 April 1867. He was graduated at Yale in 1802; in 1804–18 held a pastorate at Haddam, Conn.; and in 1819–37 at Stockbridge, Mass. In 1837–51 he was again at Haddam. In addition to sermons he published: 'History of Middlesex County, Conn.'; 'History of Berkshire County, Mass.'; 'Life of David Brainerd.'

Field, David Dudley, American jurist: b. Haddam, Conn., 13 Feb. 1805; d. New York 13 April 1894. He was a son of the preceding; was admitted to the New York bar in 1828; and practised till 1885, distinguishing himself especially by his labors in the direction of a reform of the judiciary system. In 1857 he was appointed by the State to prepare a political, civil, and penal code, of which the last was adopted by New York, and all have been accepted by some other States. In 1866, by a proposal brought before the British Social Science Congress, he procured the appointment of a committee of jurists from the principal nations to prepare the outlines of an international code, which were presented in a report to the same congress in 1873. This movement resulted in the formation of an association for the reform of the law of nations, and for the substitution of arbitration for war, of which Mr. Field was the first president.

Field, Edward, American antiquarian: b. Providence, R. I., 4 Oct. 1858. He was for years a school commissioner of Providence and served as city auditor pro tem. He was made clerk of probate 1889, and record commissioner of Providence 1891, is a member of several historical societies, and is historian of the Rhode Island Society of the Sons of the American Revolution. He has published: 'Tax Lists of the Town of Providence during the administration of Sir Edmund Andros and his Council 1686–1689' (1895); 'Revolutionary Defenses in Rhode Island' (1896); 'The Colonial Tavern' (1897); 'Esek Hopkins, Commander-in-Chief of the Continental Navy During the American Revolution 1775–1778' (1898); etc.

Field, Eugene, American journalist: b. St. Louis, Mo., 2 Sept. 1850; d. Chicago, Ill., 4 Nov. 1895. By his poems and tales in the press he won a high reputation in the West, which before his death had become national. His poems for children are admirable in their simplicity and in their sympathetic insight into the child's world of thought and feeling. His more important works comprise: 'Culture's Garland' (1887); 'Love Songs of Childhood'; 'A Little Book of Western Verse'; 'A Little Book of Profitable Tales' (1889); 'A Second Book of Verse'; 'The Holy Cross, and Other Tales'; 'The Love Affairs of a Bibliomaniac.' In collaboration with his brother, R. M. Field (q.v.), he published translations from Horace, 'Echoes from the Sabine Farm.'

Field, Henry Martyn, American clergyman and scholar: b. Stockbridge, Mass., 3 April 1822; d. there 26 Jan. 1907. He was graduated at Williams College, and was ordained to the ministry in 1842. In 1854 he became editor and proprietor of the New York 'Evangelist.' He was a lifelong traveler. Among his works are: 'Summer Pictures from Copenhagen to Venice' (1859); 'History of the Atlantic Telegraph' (1866); 'From the Lakes of Killarney to the Golden Horn' (1876); 'From Egypt to Japan' (1878); 'On the Desert' (1883); 'Among the Holy Hills' (1883); 'The Greek Islands and Turkey After the War' (1885); 'Our Western Archipelago'; 'The Barbary Coast'; 'Old Spain and New Spain'; 'Gibraltar'; 'Bright Skies and Dark Shadows.'

Field, Marshall, American merchant: b. Conway, Mass., 18 Aug. 1835: d. New York City 16 Jan. 1906. He received a common school and academic education in the intervals of labor on his father's farm. At 17 he entered a dry goods store in Pittsfield, Mass., as clerk, soon mastered the details of the business, and in 1856 removed to Chicago, where he entered the employ of Cooley, Wadsworth & Co., a pioneer mercantile house. In 1860 he was admitted to a junior partnership in the firm, which then became Cooley, Farwell & Co., and later Farwell, Field & Co. On the dissolution of this partnership the firm of Field, Palmer & Leiter was formed in 1865, and on the retirement of Palmer, two years later, the firm name became Field, Leiter & Co. In 1881 the Leiter interest was purchased by Mr. Field and the business was afterwards continued under the firm name of Marshall Field & Co. Prior to the Chicago fire of 1871 the sales amounted to $12,000,000 annually, but have since steadily increased to more than $60,000,000, the firm being now the largest dry goods house in the world. The single large building, which it occupied before the fire, has been replaced by one much larger devoted to the retail trade, the wholesale business being carried on in an immense building covering an entire block. In addition to these two vast establishments the house has offices in New York, England, France, Germany, Switzerland, and Japan. Avoiding ostentation Mr. Field was a liberal and discriminating giver. In addition to the Field Columbian Museum (q.v.) given by him to Chicago, he bestowed gifts upon the University of Chicago, and to his native town of Conway he gave and endowed a public library, at a cost of $200,000, in memory of his parents.

Field, Mary Katherine Kemble, American author and lecturer: b. Saint Louis, Mo., 1838; d. Honolulu, Hawaii, 19 May 1896. Among her books are: 'Planchette's Diary' (1868); 'Ten Days in Spain' (1875); 'History of Bell's Telephone'; 'Life of Fechter'; 'Haphazard'; etc. Consult Whiting, 'Kate Field.'

Field, Stephen Johnson, American jurist: b. Haddam, Conn., 4 Nov. 1816; d. Washington, D. C., 9 April 1899. He was the second son of the Rev. David Dudley Field (q.v.), and a brother of David Dudley Field (q.v.), jurist and law reformer and of Cyrus W. Field (q.v.), the inventor of the Atlantic cable. When he was 13 years of age young Field journeyed to the East with his brother-in-law, who was a missionary, and spent three years in Smyrna and Athens, studying Greek and other languages. After returning to America he graduated at Williams College, and for a time thereafter studied law in New York city. In 1848, soon after he was admitted to the bar, he went to Europe where he remained for one year. In 1849 he joined the rush of easterners to the new gold diggings in California, and settled at the mining camp known as Yubaville, since called Marysville. Here he was elected first alcalde under the old Mexican law of that region, holding office until the organization of the judiciary under the Constitution of the State. In 1850 he was elected to the State Legislature and was placed on the judiciary committee. He drew up several bills providing for articles in the State Code and some of his laws for miners and mining were afterward adopted by other States. In 1857, he was elected judge of the supreme court of California and two years later succeeded Judge Davis S. Terry (q.v.) as chief justice. The decisions of Justice Field in the next few years had much to do with the law of real property and large areas of disputed property was assigned to legal ownership through his decision. In 1863, President Lincoln appointed him an associate justice of the Supreme Court of the United States, which important position he held until 1897. Among his important decisions and opinions were those of the income tax cases, test oath cases and legal-tender cases. He became eminent as one of the most celebrated authorities on constitutional law. In 1876 he was a member of the famous electoral commission which decided the Presidency in favor of Rutherford B. Hayes of Ohio, as against Samuel J. Tilden of New York. His service on the bench of the Supreme Court was the longest in the history of that learned body.

Field of the Cloth of Gold, a spot in the valley of Andren, between the English castle of Guisnes and the French castle of Ardres, celebrated for the meeting between Henry VIII. of England, and Francis I. of France, attended by the flower of nobility of both nations. The meeting took place 7 June 1520, and had been planned by Cardinal Wolsey, to enable the two kings to come to an understanding as to an alliance against Charles V. of Spain.

Field, Columbian Museum, a scientific institution of Chicago, Ill., established through gifts by Marshall Field (q.v.) and other citizens, and opened in 1894.

Field Cricket, a large European cricket (*Gryllus campestris*), found in hot, sandy localities, where it burrows. See CRICKET.

Field Dogs, a general name applied by sportsmen to such dogs as assist them in field sports, such as pointers, setters, spaniels, and the like. See DOG.

Field, Magnetic, or **Field of Magnetic Force,** a term introduced by Faraday to designate any space possessing magnetic properties. A space may possess magnetic properties either on account of magnets in its vicinity, or on account of currents of electricity passing through or round it. See ELECTRICITY; ELECTRO-MAGNETISM; FARADAY; MAGNETISM.

Field-marshal, the highest military dignity in Great Britain, Germany, and other European countries. George II. introduced the title into England when, in 1736, he created the Duke of Argyll and the Earl of Orkney field-marshals, but it had been long in use in the German armies, and is of German origin. In Great Britain the dignity is conferred by selection and is held by but few officers, and chiefly for distinguished services or on the ground of royal descent.

Field Mice, or Voles, any wild mouse, dwelling in fields and open places, may be called a field mouse; but the name applies more strictly to the robust, short-tailed mice of the arvicoline group of the family *Muridæ*, representatives of which occur throughout the north temperate zone, and are known in Great Britain as «voles.» The same group includes the lemmings, muskrats and other vole-like mice dwelling in the woods. The common field-mice of the United States and Canada are of the genus *Microtus*, and the common eastern «meadow-mouse» (*M. pennsylvanicus*) is distributed over the whole continent, showing many local variations in color and form. It is 5½ inches long, with the tail 1½ inches; grayish brown with chestnut tinges, blackish on the spine, and hoary below. A near relative of the upper Mississippi valley is the prairie meadow-mouse (*M. austerus*), which is larger and more uniformly gray; and another is the southern pine-mouse (*M. pinetorum*), whose coat is rusty brown, short, dense and silky. Other species are distinguished on the Pacific coast. These mice feed mainly upon seeds and bark, and often do vast damage in grain fields, where they not only eat or shake down a large percentage of the crop, but occasionally overrun the country in vast hordes suitably described as «plagues.» This has happened repeatedly in Europe, where the offending species was the very common field-vole (*M. agrestis*), whose inroads have sometimes nearly produced famine in southern Russia. In winter these pests of the farmer are likely to nibble the bark from young fruit-trees until they have been fatally girdled. These mice dwell in shallow burrows, or make nests of grass in various hiding places, being especially fond of working their way into grain stacks and storage-cellars. They pass the winter in these retreats, sustained by a store of seeds, etc., but hibernating only during the severest weather. The best way to combat them is not to kill off their natural enemies, the hawks, owls, harmless snakes and small carnivores. To the unwise destruction of these is due most of the «plagues» of mice. Consult Audubon and Bachman, ‹North American Quadrupeds› (1846); Godman, ‹Natural History› (1834); Kennicott's papers in the Annual Report of the U. S. Department of Agriculture for 1857; Ingersoll, ‹Wild Life of Orchard and Field› (1901); and Stone and Crane, ‹American Animals.›

Field Plover, a sportsmen's name for several different shore-birds, most commonly meaning the upland or Bartramian sandpiper (*Bartramia longicauda*), which resembles a killdeer (q.v.) in habits, but is not a true plover. It is 12 to 13 inches long, light-brownish, marked with ochraceous and blackish; throat nearly white, and tail-feathers mostly marked with white. It is related to the European ruff.

Field Spaniel. See Dog.

Field Sparrow, a small familiar sparrow (*Spizella pusilla*) of North American fields and meadows, closely related to the garden chipping-sparrow (q.v.), from which it differs in being slightly larger and much paler in colors. Its song, however, more resembles that of the song-sparrow. It nests on the ground, and lays white eggs speckled with reddish and purple.

Fieldfare, a European thrush (*Turdus pilaris*) prevailingly grayish-brown with darker markings and lighter under parts. It breeds in Scandinavia and northern Russia, making nests in companies in trees, and visits Great Britain and southern Europe in winter, where it is largely shot for market.

Fielding, Anthony Vandyke Copley, English painter in water colors: b. about 1787; d. Worthing, Sussex, 3 March 1855. He early attracted attention by his water-color landscapes; gained also considerable reputation as a teacher, and for many years before his death was president of the Society of Painters in Water Colors. His pictures are chiefly taken from English scenery, the various features of which, both in rich woodland and open plain, he has represented with great delicacy and truth.

Fielding, Henry, English novelist: b. Sharpham Park, near Glastonbury, in the county of Somerset, 22 April 1707; d. Lisbon, Portugal, 8 Oct. 1754. His parents were Lieutenant Edmund Fielding and his wife Sarah, daughter of Sir Henry Gould. It is believed that in the characters of Lieutenant Booth and Amelia, Fielding long afterward revived the figures of his young father and mother. By an old legend, put into magnificent form by Gibbon, the novelist was supposed to have descended from the Hapsburgs, but their connection with the ancient family of the Earls of Denbigh, to which the novelist certainly belonged, is now exploded. The Fieldings of Sharpham, though of moderate means, were well connected; the novelist's cousin was the famous Lady Mary Wortley Montagu. In 1710 his parents removed, on the death of Sir Henry Gould, to East Stour in Dorsetshire, where Sarah Fielding (1710–1768), Henry's sister and the gifted author of ‹David Simple,› was born. To his childish adventures by the «pleasant banks of sweetly-winding Stour» Henry gives due record in ‹Tom Jones.› He was 11 years of age when the family moved again, after the death of Mrs. Fielding in 1718, and Henry was transferred to Eton. There is no record of his residence in the registers of the school, so that he was probably an oppidan. Murphy tells us that Fielding, when he left Eton, about 1726, «was said to be uncommonly versed in the Greek authors, and an early master of the Latin classics;» Fielding himself tells us that he knew Italian and French, could write Latin and could read Greek. The early idea that he was a poorly-educated man was based on prejudice and ill-will. Pitt and Fox were among his comrades at Eton. Before he left school, he fell in love with Sarah Andrew, a young lady of Lyme Regis, and even planned her abduction, but the affair was discovered by her guardians, who prevented the romantic act, although, as the archives of the town still record, going in fear of their lives «owing to the behavior of Henry Fielding and his attendant, or man.» This Miss Andrew was said to be the original of Sophia Western.

From Eton Fielding proceeded to study law at Leyden for two years, which he did «with a remarkable application.» He settled in London early in 1728, doubtful whether to adopt, as

Austin Dobson says, the profession of hackney-writer or that of hackney-coachman; his father could no longer support him, and it was necessary for him to subsist upon his wits. He determined to turn playwright, but his earliest drama, the comedy of ‹Love in Several Masques,› had no great success. It is difficult to trace the history of Fielding further during the next two years, but in 1730 he brought out another comedy, ‹The Temple Beau,› and an extravaganza, ‹The Author's Farce.› These were not unsuccessful, and they opened a long series of dramatic performances, by means of which it would seem that Fielding obtained a precarious livelihood for the next seven years. The very entertaining burlesque of ‹Tom Thumb› (1730), especially in its extended form as ‹The Tragedy of Tragedies› (1731), deserves a high position among these plays, most of which were of somewhat ephemeral importance. In 1732 Fielding produced ‹The Modern Husband,› ‹The Covent Garden Tragedy,› ‹The Debauchees,› and ‹The Mock-Doctor;› the last-mentioned comedy was highly successful, and so was ‹The Miser,› of 1733, but Fielding's share in the profits of these pieces cannot have been large. He lived, no doubt, on what he could borrow, earn, or beg; sometimes in a London garret, sometimes in the country-house of a wealthy acquaintance. A satirist of the period describes him at this time as a «rough play-house bard,» and «clad in coarse frieze,» while his best biographer infers that his daily life must have been more than usually characterized «by the vicissitudes of the eighteenth-century prodigal.» ‹The Intriguing Chambermaid› was Fielding's principal contribution to 1734, but the prolific dramatist was now beginning to find that the town had become sated with his light any spicy confections. The date on which Fielding married Miss Charlotte Cradock, a respectable lady of independent means living at Salisbury, to whom he had for some years been attached, was long unknown, but it has recently (1906) been discovered that the marriage took place, by license, in the church of Saint Mary's, Charlcombe, close to Bath, on 28 November, 1734. It is at this time, and on Miss Cradock's money, that he has been believed to have begun «immediately to vie in splendor with the neighboring country squires,» and to have maintained a large retinue of servants, «all clad in costly yellow liveries.» This story has been criticised, and, in some of the particulars with which Murphy adorns it, it must be inexact in detail, yet it probably gives not an unfair impression of the lavish way in which, for about a year, Fielding lived in Dorsetshire in a magnificence far beyond his means. His cousin, Lady Mary, said that Henry Fielding «would have wanted money if his hereditary lands had been as extensive as his imagination,» and in a few months he was back in London, again obliged to work for a precarious living. He returned to the drama, and in 1736 took the little French Theatre in the Haymarket, where he produced the successful burlesque of ‹Pasquin,› by which he made more money than by any of his previous efforts. His career as a dramatic author, however, was checked by a Bill of 1737, in which Parliament restrained the license of the stage, and reduced the number of playhouses. The rest of the few and slight puppet-shows and farces which Fielding wrote need not be named here. His plays (they are 25 in number) although skilful and sprightly, have not the value of his novels, nor anything like their originality, and they are read to-day, if they are read at all, because they are Fielding's, and not because of their intrinsic merit.

When his company of actors was dispersed, Fielding turned to the law as a profession, and in November 1737, became a student of the Middle Temple. According to Murphy, he studied with great assiduity, but little is known of his life at this time. He eked out his legal work with the writing of «a large number of fugitive political tracts,» which were probably anonymous, and have disappeared. Late in 1739 he started a newspaper, the ‹Champion,› on the model of the ‹Tatler,› and in this journal he wrote much, until June 1740, when he was called to the Bar. He traveled the Western Circuit, and «assiduously attended the Wiltshire sessions.» He seems to have taken his duties as a barrister very seriously, but they did not prevent him from writing, and publishing in February 1742, the novel of ‹Joseph Andrews.› This began as a parody of the popular ‹Pamela› of Richardson, but soon passed on into an independent and highly entertaining study of contemporary manners. The fresh and breezy genius of Fielding mocked at the sentimentalities and the wire-drawn psychology of his predecessor, but he soon got beyond the point where it was enough for him to ridicule Richardson. He created two magnificent comic figures of his own, and he enriched English literature forever with Parson Adams and Mrs. Slipslop. It was thus that, at the age of 35, Fielding discovered, as it were by accident, the nature of the genius which he possessed. He did not, however, at once perceive the value of the discovery, but returned to his plays and his pamphlets. It was now that he published two early farces, ‹Miss Lucy in Town› (1742), and ‹The Wedding Day› (1743), as well as a much more important work, his ‹Miscellanies,› in three volumes. This was a collection of Fielding's shorter writings up to that date, and included his poems, occasional and satirical, his essays, his ‹Journey from this World to the Next,› some of his farces, and the remarkable ironic novel called ‹Jonathan Wild.› The ‹Journey› is a Lucianic allegory, full of wit and observation, but unfortunately left unfinished by the languor of the author, who evidently became weary of his design. ‹Jonathan Wild› is a work of far greater importance. It takes for its hero a notorious rogue who was hanged at Tyburn in 1725, and there is internal evidence that although not printed until 1743, it was written some years before. It is probable that it preceded ‹Pamela,› and ought to take its place as the earliest of the novels of the new school of romance. It is a powerful and painful book, «a picture of complete vice, unrelieved by anything of human feeling,» and more unflinching than anything else which Fielding has left. It is a curious thing that from this date until 1749 we have a period of six years, during which Fielding was at the height of his powers, and was not without a certain measure of celebrity, yet which have left scarcely any mark at all upon his history. How was this great man engaged from his 37th to his 44th year? Strange as it sounds, we cannot tell. Austin Dobson has brought forward arguments to show that it was a time of poverty, darkened by successive bereavements, particularly that of the loss of his wife, to whom he was most tenderly attached. A remarkable preface, prefixed to the second edition of his sister's 'David Simple,' appeared in 1744; in this he denies his authorship of the work itself. He describes himself as applied to the legal profession «with so arduous and intelligent a diligence» that he has no time for the practice of literature. He wrote a little, however, for 'The True Patriot' and other journals. In November 1747 Fielding married for the second time, and took a house at Twickenham; Mary Daniel, the second Mrs. Fielding, is said to have been her predecessor's «cook-wench.» Fielding had by this time secured an invaluable friend in George, afterwards the first Lord Lyttelton (1709–1773), who procured for him, in December 1748, the office of a Justice of the Peace for Westminster. Up to this date he had been a wanderer on the face of England, now at Salisbury, now at Twiston, at Hagley, at Twickenham, but in January 1749 he settled for good in London. John, Duke of Bedford lent or rented to him a house in Bow Street, under terms which were described as a «princely instance of generosity.» But Lyttelton was the closest of all Fielding's influential friends, and there is a remarkable passage in which the novelist states that he partly owed to Lyttelton his existence during a great part of the time spent in the composition of 'Tom Jones,' a book which, without Lyttelton's help, «had never been completed.» It used to be stated that 'Tom Jones' was written at Bow Street, but this is impossible; it was evidently the work of the desultory months of poverty which preceded Fielding's appointment as a magistrate. The famous novel was published, as 'The History of Tom Jones, a Foundling,' on 28 Feb. 1749, in six volumes, at the price of 16 shillings a set. It had an instant success, so great that, three month later, Fielding had already received £700 from Millar, the publisher. That this did not much alter the random habits and easy negligence of the author seems to be proved by a picturesque although spiteful description given by Horace Walpole, in May 1749, of Fielding dining at the house in Bow Street «on some cold mutton and a bone of ham, both in one dish, and on the dirtiest cloth,» in the company of some very questionable persons. It is well to look at the other side, and to remember, with Murphy, that Fielding «kept his table open to those who had been his friends when young, and had impaired their own fortunes.» It is certain, moreover, that he was increasingly respected by those who could overlook the carelessness of his habits and his easy nonchalance of manners.

In May 1749 he was unanimously elected chairman of Quarter Sessions, and his magisterial charges were received with all the respect which their gravity and courage demanded. How seriously he took the duties of his office is seen in his 'True State of the Case of Bosavern Penlez' (1749), in which he vindicates the severity of the law against rioters. This was a time of great lawlessness among the London lower classes, and Fielding eminently distinguished himself by his vigilance against violent criminals and by his plans for reform. But his health was already failing; he had lived too hard and too fast, and on Hurd, who met him in 1751, the novelist produced the impression, at 44 of «a poor, emaciated, worn-out rake.» There was, however, no intellectual decline, and, at the close of this same year, there appeared the very vigorous and pathetic romance, 'Amelia.' This novel has had its enthusiastic admirers, but, to the charge that it is less broad and fresh than its immediate predecessor, there is no reply. As Fielding's best biographer has said, «Behind 'Tom Jones' there was the author's ebullient youth and manhood; behind 'Amelia' but a section of his graver middle-age.» There is a remarkable sense of decline in the juvenile vigor which was so irrepressible in 'Tom Jones'; the author of 'Amelia' writes philosophically, and like an elderly man. In the figure of the heroine, however, there was no evidence of declining powers; here is the most exquisite figure of a woman that Fielding ever painted. In 1752, Fielding, although so much occupied, found the energy to start the bi-weekly, 'Covent Garden Journal,' which led him into acrimonious controversy with Smollett and others; and to collect the narratives of peculiar cases of the detection of murder which had come under his notice as a magistrate, in 'Examples of the Interposition of Providence.' In 1753 he was deeply interested, like all his contemporaries, in the mysterious case of Elizabeth Canning, who professed to have been kidnapped, and he published a pamphlet on the subject. But he was by this time greatly reduced by successive attacks of the gout, and in August of that year was ordered to retire to Bath. His going, however, and the proper treatment of his disease, were delayed by his great wish to break up a congeries of gangs of street robbers, who were committing murders in London so frequently as to alarm the government itself. But when, in December, he had at length completed this public duty, his was «no longer a Bath case,» and he was so much weakened by jaundice, dropsy and asthma, that he looked upon his condition as almost desperate. He struggled through the winter, and in June 1754 started, in search of relief, for Portugal. The tediousness and multiplied discomforts of the transit are described, with a great deal of heroism, in the 'Journal of a Voyage to Lisbon,' which was the latest and one of the best written of Fielding's works. He traveled with all his family, and they arrived in the Tagus in August. No further particulars have been preserved, but that Fielding died at Lisbon, on 8 Oct. 1754, and was buried in the beautiful cemetery of Os Cypréstres, opposite the Church of the Estrella.

With regard to the importance of Fielding's work in the development of English literature there is a complete unanimity of opinion among all competent critics. Indeed, there is scarcely a reputation which is less liable to be challenged than his. Without insisting on the title of «Father of the British Novel,»— which must belong, if it be given to anyone, to Defoe or to Richardson,— we cannot but admit that it was Fielding who first in Europe foresaw the full scope of the «comic epic poem in prose,» and that his own efforts in that direction have, at their best, never been excelled. The symmetry of his books, particularly of that matchless work of art, 'Tom Jones,' has not been surpassed, and this is the more wonderful because, until his day, no one had perceived the fact that a work of prose fiction needs to be symmetrical.

He relieved the excessive strain of feeling, which, in the case of Richardson, had sometimes amounted to a positively distressing tension, by introducing breaks of witty observation, ironic illustration, or entertaining episode, but he did this with a care for the balance of parts which makes the study of his technique extremely interesting. Byron called Fielding "the prose Homer of human nature," and in so doing he indicated the extraordinary range of sympathy which marks his delineation. There is nothing unnatural or extravagant about the incidents which he introduces, but they are such as might be expected inevitably to happen to such very natural characters as the novelist depicts.

It has been said that Fielding lacked the imaginative faculty. It would be more correct to say that he distrusted the fantastic and preposterous parts of invention, since, if imagination is the power to bring up before one's own mental vision, and to reproduce for others with fidelity a consistent chain of phenomena, then Fielding was fully endowed with that gift. His pictures are remarkable for their brightness, their freshness, the sharpness and illumination of their outline. His invention occupied itself, not with the unusual, but with the obvious scenes of life, which in his day were, fortunately, still unhackneyed. He wrote slowly and finished late; he did not hasten to exhaust the stores which adventure and experience had given him; he had warmed both hands before the fire of life, and he gave back to the world in his books what he received from it in his own rough-and-tumble youth. From Fielding we must not look for pathos or romantic sentiment,— although even these are not wholly missing,— but we must look for humor, breadth of sympathy, a genial buoyancy, a wholesome recognition of the appetites, a philosophic consideration of the limitations of human frailty, and these we find in his wonderful novels to a degree which we may without fear of exaggeration confess to be elsewhere unparalleled.

Bibliography.— Fielding's earliest biographer was Arthur Murphy (1727–1805), who prefixed an essay on his life and genius to the first collected edition of his 'Works' (1762). Murphy's inexactitudes were pointed out by Lawrence in 1855, and by Keightley in 1858, but by far the most accurate and dispassionate life of Fielding is that published by Austin Dobson in 1883. Subsequent editors and biographers have been content to borrow the main part of their information from this admirable monograph, which has been corrected by the author in successive editions, and is now not likely to be superseded as the standard authority on the life and bibliography of Henry Fielding.

Edmund Gosse,

Author of 'History of 18th Century Literature'; 'History of Modern English Literature'; etc.

Fielding, Sarah, English novelist: b. East Stour, Dorsetshire, 8 Nov. 1714; d. Bath, Somerset, April 1768. She was the third sister of Henry Fielding (q. v.). She was the author of the novel 'David Simple' (1744); 'The Governess' (1849); 'The Cry, a Dramatic Fable' (1757); Xenophon's 'Memoirs of Socrates,' translated from the Greek; 'The Countess of Delwyn'; 'The History of Ophelia'; 'The Lives of Cleopatra and Octavia'; etc.

Fielding, William Stevens. Canadian statesman: b. Halifax, Nova Scotia, 24 Nov. 1848. He was educated in Halifax; for 20 years was connected with the Halifax 'Morning Chronicle,' becoming managing editor; but resigned that position to enter public life. From 1882–96 he represented the city and county of Halifax in the Provincial Legislature, soon after his election becoming a member of the Cabinet and from 1884–96 Prime Minister. In 1896 he resigned to enter the Cabinet of Sir Wilfred Laurier as Minister of Finance. He also represents the electoral district of Shelburne and Queen's in the Dominion Parliament. He represented Canada at the Colonial Conference, London, 1902, and is a governor of Dalhousie University. Among other important works, he has readjusted the Canadian tariff, submitted to Parliament, the British preferential tariff, and later the measure imposing a surtax on German products, and legislation regarding the so-called "dumping" system.

Fields, Annie, (Adams), American poet and essayist, wife of James T. Fields (q.v.): b. Boston, Mass., 6 June 1834. She has long been prominent in charity organizations and has published: 'Under the Olive,' poems (1881); 'Biography of James T. Fields' (1884); 'How to Help the Poor' (1885); 'The Singing Shepherd'; 'Authors and Their Friends'; 'A Shelf of Old Books' (1896); 'Life and Letters of Harriet Beecher Stowe' (1897); 'Whittier: Notes of His Life and Friendships'; 'Nathaniel Hawthorne' (1899); 'Orpheus a Masque' (1900).

Fields, James Thomas, American publisher and author: b. Portsmouth, N. H., 31 Dec. 1817; d. Boston 24 April 1881. He went to Boston in 1834, becoming junior partner of the firm of Ticknor, Reed & Fields in 1839, later known as Ticknor & Fields, and Fields & Osgood. He edited the 'Atlantic Monthly' 1862–70; and was an acceptable lecturer on literary subjects and authors. He published: 'Poems' (1849); 'A Few Verses for a Few Friends' (1858); 'Yesterdays with Authors' (1872); 'Hawthorne' (1875); 'Old Acquaintance: Barry Cornwall and Some of His Friends' (1875); 'In and Out of Doors with Dickens' (1876); 'Underbrush' (1881). Essays: 'Ballads and Other Verses' (1881): and (with E. P. Whipple) edited 'The Family Library of British Poetry' (1878).

Fieri Facias, fī'ĕ-rī fā'shĭ-as, in law, is a judicial writ of execution issued on a judgment, by which the sheriff is ordered to levy the amount of the judgment on the goods and chattels of one party, for the benefit of another. Abbreviated to *fi. fa.* See Execution.

Fieschi, or **Fiesco, Giovanni Luigi de,** jō-vän'nē loo ē'jē dē fē-es'kē or fē-es'kō, Count of Lavagna, Italian conspirator: b. Genoa 1523; d. there 2 Jan. 1547. He became master of a large patrimony at the age of 18, and being surrounded with dependents and flatterers, and really possessing considerable talents and eloquence, was readily induced to aim at that power and distinction in the state which was then possessed by the family of Doria, headed by the famous Andrea Doria, doge of Genoa. He attempted to kill the doge and overthrow the government, but was unsuccessful in both endeavors, and in his efforts to seize the public galleys was accidentally drowned.

Fieschi, Giuseppe Maria, fe-es'ke, Corsican conspirator: b. Corsica 3 Dec. 1790; d. Paris 16 Feb. 1836. Having conceived a hatred for the French king, Louis Philippe, he constructed an infernal machine of about 100 gun-barrels fixed in a frame, which he discharged simultaneously, by means of a train of gunpowder from a house in the Boulevard-du-Temple, during a review of the National Guard 28 July 1835. The king escaped unhurt, but Marshal Mortier and 17 people were killed, and many more wounded. Fieschi and his accomplices, Pepin and Morey, were guillotined.

Fiesole, Fra Giovanni Da. See FRA ANGELICO.

Fiesole, fē-ā'sō-lĕ (ancient FÆSULÆ), Italy, city about four miles northeast of Florence. Under the name of Fæsulæ it was one of the 12 Etruscan cities, and a place of importance. It submitted, with the rest of Etruria, to the Roman power (90 B.C.), and was colonized by Sylla. In the commencement of the 11th century it was destroyed by the Florentines, and a number of its inhabitants transported to Florence. It contains many interesting Etruscan ruins; but it is noted as being the place where Fra Angelico (q.v.) lived for a number of years. Pop. 5,000.

Fiévée, Joseph, zhō-zeph fyā-vā, French journalist: b. Paris 10 April 1767; d. there 7 May 1839. His experiences during the French Revolution were not happy, largely in consequence of his work: 'On the Necessity of a Religion' (1795); but the Napoleonic rule proved more favorable to him. He subsequently wrote two novels, 'Suzette's Dowry'; and 'Frederick'; besides historical works on aspects of the republic, consulate, and empire.

Fife, a wind-instrument, known from very early times and used chiefly in military music. It resembles a small flute in its form and method of performance, seldom having any keys, and never more than one. It has six finger holes. Fifes are of several kinds. Those tuned to the key of C are shortest and highest, and are much oftener used; they have a compass of two octaves. The instrument is characterized by a clear and piercing tone.

Fifer, Joseph W., American soldier and public man: b. Staunton, Va., 20 Oct. 1840. When a boy he went with his parents to Illinois, and enlisted in the Union army in 1861; he was wounded at the battle of Jackson in 1863, but rejoined his regiment and served until 1864. After the war he was graduated from the Illinois Wesleyan University, studied law, and was admitted to the bar. He was corporation counsel for the city of Bloomington in 1871, and State's attorney for McLean County 1877–80. In 1880 he was elected to the State senate and served four years; in 1888 he was elected governor of Illinois on the Republican ticket, but in 1892 was defeated for re-election by Altgeld. In 1904 he was appointed a member of the Interstate Commerce Commission.

Fifteen Decisive Battles of the World, a noted work by Sir Edward Shepherd Creasy, published 1852. It describes and discusses (in the words of Hallam) "those few battles of which a contrary event would have essentially varied the drama of the world in all its subsequent scenes." The volume treats, in order: The Battle of Marathon, 413 B.C.; Defeat of the Athenians at Syracuse, 413 B.C.; The Battle of Arbela, 331 B.C.; The Battle of the Metaurus, 207 B.C.; Victory of Arminius over the Roman Legions under Varus, 9 A.D.; The Battle of Châlons, 451; The Battle of Tours, 732; The Battle of Hastings, 1066; Joan of Arc's Victory Over the English at Orleans, 1429; The Defeat of the Spanish Armada, 1588; The Battle of Blenheim, 1704; The Battle of Pultowa, 1709; Victory of the Americans over Burgoyne at Saratoga, 1777; The Battle of Valmy, 1792; The Battle of Waterloo, 1815.

Fifth, one of the five equal parts into which any unit may be divided. In music, it is a distance comprising four diatonic intervals, that is, three and a half tones. It is the second of the consonances in the order of their generation. As consecutive fifths do not produce a good effect, they are not allowable in harmony. There are three kinds of fifths: namely, the perfect fifth (C — G), consisting of three whole tones and a semitone; the flat, diminished, or imperfect fifth (B — F), consisting of two whole tones and two semitones; and the extreme sharp, or superfluous fifth (C — G sharp), composed of four whole tones.

Fifth Monarchy Men, a set of politico-religious enthusiasts who sprang up during the Protectorate of Cromwell. They believed that the four great kingdoms mentioned by Daniel, the Assyrian, the Persian, the Grecian, and the Roman, were to be followed by the descent of Christ, to establish a fifth monarchy, which was to be of world-wide extent. They thought that this advent was close at hand, and that physical force should be employed to pave the way for Christ's reign. When the sect, who were of the extreme republican type, fancied Cromwell was aiming at the royal title as well as power, they raised a conspiracy against him (1657), which was quickly discovered. Their leaders were thrown into prison, and were only liberated on the death of the Protector. The sect became extinct shortly after the Restoration.

Fifth Nerve, the chief sensory nerve of the face, also called trigeminus, or trifacial. It is one of the fifth cranial pair of nerves. The fifth nerve is one of the most important sensory nerves of the body, its name trafacial meaning that it has three large divisions which are distributed to the face, and its name trigeminus being given because it has three roots inside the skull. It is really a mixed nerve containing both motor and sensory fibres. The motor root rises from a group of cells lying deep in the floor of the fourth ventricle. The sensory portion arises in a series of ganglia, the Gasserian ganglion being the most important one. The ophthalmic and Meckel's ganglia are also smaller ganglionic centres. The chief branches go to supply the entire area of the skin of the face and head, and neuralgias and neuritides of the face and head are due to affections of this nerve. The chief division is the first or ophthalmic division, which supplies the region over the superior surface of the nose, forehead and eye, running as far back as the top of the head. The second branch is the superior maxillary, which supplies the teeth and the region of the skin beneath the orbit, the upper lip, and the region of the temple. The superior maxillary nerve constains a few motor fibres. The third branch, the inferior maxillary, or mandibular, is the largest branch of the fifth nerve, and contains most of the motor fibres. It supplies the surface of the skin of the lower jaw, front of the ear, and temporal region, lying close behind the area supplied by the maxillary. The muscles of the jaw, the masseters, temporals and buccinators are supplied by the motor fibres of this branch. See CRANIAL NERVES; FACIAL NEURALGIA; NEURALGIA.

Fifty-four Forty or Fight, the slogan of the Northern Democrats in 1844; meaning the insistance upon the line of lat. 54° 40′ N. as the southern limit of English possession, even at the price of a war. The Ashburton Treaty of 1842 had created great dissatisfaction as a surrender of American rights (and in England as a surrender of British rights), and the hot-heads wished to abrogate it. But the Southern leaders did not wish to make war for the increase of free territory, and instead diverted the war sentiment against Mexico, forcing on the Mexican war of 1847.

Fig, the fruit of the *Ficus carica,* a native of Asia, Africa, and the south of Europe, which has been cultivated from remote antiquity in the countries surrounding the Mediterranean, where figs form a principal article of food in many places. It belongs to the natural order *Artocarpaceæ,* sub-order *Moreæ.* The male and female flowers are mixed indiscriminately on the inside of a fleshy receptacle, which is concave in form, with its edges drawn together into a narrow opening. What are called the seeds in the ripe fig are the pericarps, each containing a single seed. The fig-tree is distinguished from almost all others by the extraordinary property of producing two crops of fruit in the same year on distinct shoots, in climates congenial to its growth. The shoots formed by the first or spring sap put forth figs at every eye as soon as the sap begins to flow again in July and August. These figs which form the second crop of the year ripen in their native climate during the course of the autumn, but rarely if ever come to perfection in England. The shoots formed by the second flow of sap, commonly called midsummer shoots, put forth figs in like manner at every eye, but not until the first flow of sap in the following spring. These last-mentioned figs, which form the first crop of each year, ripen in warmer climates during the month of June and July, but not in this country before September or October. The fig-tree, in its wild state, is a low, distorted shrub, bearing fruit destitute of any agreeable flavor. Dried figs are easier of digestion and more nourishing than the fresh fruit, and form a considerable article of commerce. The best come from Turkey, Italy, Spain, and Provence; those of the Archipelago are inferior in quality. Dried figs, with barley bread, are now the ordinary food of the lower classes in Greece and the Archipelago. While the edible fig of commerce can be raised over the whole United States south of Philadelphia, fig culture was never considered a practical venture until a few years ago. American figs even in such a climate as California were shrunken and sour for the most part, and the dried Smyrna fig was still imported to the United States to the value of about $700,000 a year. As the price of other kinds of native fruit decreased, because of overproduction, many Californian orchardists and horticulturists turned their attention to the fig, which is among the costliest of dried fruits, being valued at from $200 to $400 a ton in the New York market. Cuttings of the Smyrna fig were imported to this country as early as 1880, but the fruit proved shrunken and tasteless. It was found necessary to start from seedlings and for this process caprification (q.v.) was necessary. In 1891 a consignment of *Blastophaga grossorum* was brought to this country. It was received by James Shinn of Niles, Cal., who had planted a caprifig tree in his orchard as a hospice for the insects. He failed of success through the lateness of the season at which he made the experiment, which, however, was repeated by George C. Rœding of Fresno, Cal., who met with complete success, and now Smyrna figs are produced in California as large and highly sugared as those which can be imported.

Fig-eater, a beetle of the genus *Allorhina* harmful to figs. See JUNE BEETLE.

Fig Fertilization by Insects. It was known to the ancients, according to Pliny and others, that the cultivation of certain varieties of figs was dependent for fertilization (technically termed caprification), upon the friendly aid of a minute hymenopterous insect termed the fig-wasp (*Blastophaga grossorum*). Beginning about 1890 numerous attempts were made to introduce the Smyrna and caprifigs in fig-growing sections of America. Recognizing our inability to fertilize the female varieties which were introduced, experiments were made with mechanical pollination the following year on the Smyrna fig by Dr. Gustav Eisen. Attempts were then made to introduce the Blastophaga, but without success, until the United States Department of Agriculture succeeded in establishing the insect in 1899 in the fig-orchard of Geo. C. Rœding, at Fresno, Cal. The principle of the fertilization is that the Blastophaga in its native home in the Mediterranean region breeds naturally in the wild or caprifig. The Smyrna fig does not mature fruit unless the flowers are cross-pollinated by hand methods or through the agency of the Blastophaga, which carries pollen from the male caprifig to the female Smyrna fig, hence both the caprifig and the Blastophaga are necessary in order that the commercial fig bear edible fruit. The results of the introduction of this fig-fertilizing insect have exceeded the most sanguine expectations. In 1900 a large crop of Smyrna figs was raised, dried, and placed on the market, and tests made by experts showed that California figs fully equal the imported product, and that they contain a larger percentage of sugar, a superior flavor, and are cleaner and more attractive in appearance. With this introduction a new horticultural industry of great future value to the country has been established. The United States Department of Agriculture has published much information on this subject, two important papers being Howard's 'Fig-culture in the United States' (1900); and Eisen's, 'The Fig, Its History, Culture and Curing' (1901).

Figaro, fē'gä-rō, a noted dramatic character, brought by Beaumarchais on the stage in Paris, about 1785, in his two dramas, the 'Barbier de Seville,' and 'Mariage de Figaro.' Since that time, Mozart, Paesiello, Rossini, and others, have made the name celebrated in classic operas; and now the term is frequently used to denote an adroit and cunning accomplice. *Figaro* is also the name of a Paris journal founded 1826 but suspended from 1833–54, when it was revived by Villemessant (q.v.).

Fighting-fish (*Betta pugnax*), a small fish of the climbing perch family (*Anabasidæ*), a native of the southeast of Asia, remarkable for its pugnacious propensities. In Siam these fishes are kept in glass globes for the purpose of fighting, and extravagant gambling takes place on the result. When the fish is quiet its colors are dull, but when irritated it glows with metallic splendor. The king of Siam derives a considerable revenue from the licenses for fish-fights.

Fighting Joe Hooker, a nickname popularly applied to Gen. Joseph Hooker (q.v.).

Fighting Parson, The, a nickname given to William Gannaway Brownlow (q.v.), in reference to the vigorous anti-secession leaders written by him for his newspaper, *The Whig*, of Knoxville, Tenn.

Figig, fē-gēg, a town of considerable importance in Morocco; situated on the east bank of the Wady Zusfava, which separates Algeria from Morocco. Figig is several hundred miles from the seacoast.

Figueras y Moracas, Estanislao, ās-tän-is-lä'o fē-gä'räs ē mō-rä'käs, Spanish statesman: b. Barcelona 13 Nov. 1818; d. Madrid 11 Nov. 1882. He studied law at Madrid and early in life began political activity in the Republican party. He was elected deputy from Barcelona 1851, becoming a leader of his party, but was exiled for participation in the plot against Narvaez for a few months in 1867. After the fall of Queen Isabella he continued to oppose actively the restoration of the monarchy. Upon the abdication of Amadeus in 1873 he became president of the council of ministers, but after the restoration of the monarchy in December 1874, took no further part in public affairs.

Figueras, fē-gä'räs, Spain, town, in a plain 21 miles north-northeast of Gerona. It is defended by a fortress, considered the strongest in Spain. It is large enough to accommodate 20,000 soldiers. It has some manufactures, chief of which are woolen and linen fabrics, leather, soap, corks, etc., and a trade in these and in grain, oil, and liquors. Pop. 11,912.

Figueroa, Francisco de, frän-thēs'kō dā fē-gä-rō'ä, Spanish poet: b. Alcala de Henares 1540; d. 1620. He was called by his contemporaries "the Divine Figueroa," and at Rome he won the poet's crown. He wrote verse with equal facility and elegance in Castilian and Italian. When dying he burned all his verses; but they were published — including the celebrated volumes of eclogues in blank verse, the 'Tirsi' — from copies in the hands of his friends.

Figueroa, Francisco, Mexican annalist: b. Toluca 1730; d. City of Mexico 1800. He was a Franciscan priest and taught and lectured acceptably, but his great service to literature consisted in the compilation of materials for a history of Mexico, among them a 'History of the Conquest of New Galicia,' by Mota Padilla, besides diaries and letters.

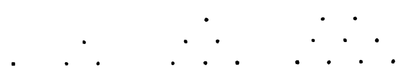
Figueroa, Francisco Acuña (ä-koon'yä) **de,** Uruguayan poet: b. Montevideo 1791; d. there 6 Oct. 1862. A civil-service post afforded him leisure to prepare his 'Poetic Mosaic' (1857), a verse collection, and his more notable 'Paraphrases of the Psalms'; and 'The Toráidas,' a series of Paraguayan notes. He has been assigned a high rank by competent European critics; lofty inspiration and sonorous diction being his characteristics, as exemplified in the 'National Hymn of Uruguay.'

Figuier, Guillaume Louis, gē-yōm loo-ē fē-gyā, French scientist: b. Montpellier 15 Feb. 1819; d. Paris 12 Nov. 1894. He was for a time professor in the School of Pharmacy of his native town, and in 1853 was appointed to a post in a similar school at Paris. Among his works are: 'Exposition et Histoire des Principales Découvertes Scientifiques Modernes' (6th ed. 1862); 'Histoire du Merveilleux dans les Temps Modernes' (1859–62); 'L'Alchimie et les Alchimistes'; 'Vies des Savants Illustres depuis l'Antiquité jusqu'au XIX. Siècle' (2d ed. 1875); 'Les Grandes Inventions'; 'Le Tableau de la Nature' (1862–73); 'Le Lendemain de la Mort' (10th ed. 1894); etc. Several of his works have been translated into English, including different sections of the 'Tableau,' such as 'The Mammalia'; 'Birds and Reptiles'; etc.

Figurate Numbers, or **Figurate Series,** in mathematics, a series of numbers which may or do represent some geometrical figure, in relation to which they are always considered, as triangular, pyramidal, hexagonal, etc., numbers. The general term of each series is

$$\frac{n(n+1\ (n+2)\ \ .\ \ .\ \ (n+m)}{1.2.3.4.\ \ .\ \ .\ \ .\ \ (m+1)},$$

in which m determines the nature of the series and n is dependent upon the place of the required term of the series. Figurate series are divided into orders: when $m=0$, the series is of the first order; when $m=1$, the series is of the second order; when $m=2$, the series is of the third order, and so on. The figurate series of the first order is the series of the natural numbers, $1, 2, 3, 4, 5\ .\ .\ .\ n$. The figurate series of the second order has for its general term $\frac{n(n+1)}{1.2}$, and the several terms are deduced from this by making in succession $n=1, 2, 3, 4$, etc. The resulting series is $1, 3, 6, 10, 15, 21\ .\ .\ .\ .\ \frac{n(n+1)}{1.2}$, etc. The numbers of this series are called triangular numbers, because they express the number of points which may be arranged in triangles, thus:



etc. The series of square numbers is 1, 4, 9, 16, 25, 36, 49, etc. The series of pentagonal numbers is 1, 5, 12, 22, 35, 51, etc.; and of hexagonal numbers 1, 6, 15, 28, 45, 66, etc.

Figure, in arithmetic, a character employed to represent a number. The Arabic figures are 1, 2, 3, 4, 5, 6, 7, 8, 9, 0, by combinations of which any possible number can be represented. (See NOTATION.) In logic, the form of the syllogism with respect to the position of the middle term. In music, a form of melody or accompaniment maintained throughout the phrase in which it is suggested. In a melody, figure is called sequence. In harmony, a figure relates to the rhythmical observance of a certain form in all the accompanying chords to the melody. Also a musical phrase, or a florid melody.

Figured Bass, in music, a bass having the accompanying chords suggested by certain numbers above or below the notes. It is at present the most satisfactory system of musical shorthand. The whole of the notes are not always indicated by a corresponding number of figures, because one number generally implies two or more to complete the chord. When there is no figure, it is understood that the common chord of such a note is to be used as its harmony.

Figured Counterpoint, in music, is where several notes of various lengths, with syncopations and other ornamental lengths are set against the single notes of the canto fermo.

Fiji, fē'jē, or **Viti** (vē'tē) **Islands,** a large group of islands in the South Pacific, situated between lat. 15° 48′ S. and 20° 4′ S. and between lon. 177° 51′ E. and 178° 38′ E. There are 255 islands great and small, of which about 80 are inhabited. The uninhabited islands scarcely rise above the level of the sea. Including Rotumah, which belongs to the same jurisdiction, they have an area of 8,045 square miles, of which the main island Viti Levu takes up 4,250 square miles, and Vanua Levu 2,600 square miles. Suva, on the south coast of Viti Levu, is the capital, with a population (European) of 1,073. The whole group is of coral formation, and all the islands seem originally to have formed portions of Viti Levu, some of them probably of Vanua Levu. The conformation of the main island is volcanic and side by side with volcanic deposits are granite, diorite, gabbros and syenite. The silent craters are most numerous in Taviuni. Among valuable metals found in the islands are gold, copper and iron. The islands lie in the track of the monsoons, which blow strongly from April to November, rendering the islands exceedingly healthy; there is an abundant rainfall, and the average temperature for the 12 months is 58° F.; the coldest month (July) has an average of 57°, and the hottest month of 59°. The flora of the Fijis is very like that of the East Indian mainland. Up to the summits of the volcanic peaks stretches a luxuriant growth of tropical vegetation. The forest has little underwood, but abounds in palms, tree ferns, bamboo, and orchids of tree-like dimensions. The fauna belongs to the south Australo-polynesian group; bats and rodents are the only mammals in the islands. There are about 50 species of birds of which the most notable are doves and parrots. The native population is gradually decreasing. The Fijians were once idolators, but since the arrival of English Wesleyan preachers in 1835 they have turned to Christianity. There are 10,402 Roman Catholics in the islands and 103,829 Protestants. There are three newspapers in Suva, and one in Levuka. The principal occupation of the people is agriculture; the sugar, maize and cocoa culture is prosperous, but cotton growing has declined. Tropical fruits are exported to Australia and New Zealand. The island now contains live stock of 4,950 horses, 36,385 horned cattle, 2,971 sheep, and 19,446 goats. Many herds of swine run wild in the forests. There seems a promising improvement recently noticeable in the prosperity of the islands. Of late years the total exports, consisting principally of sugar, copra, fruit, distilled spirits, bêche-de-mer, maize, and vanilla, are about $3,000,000, and imports, of which the principal item is under the heading of «drapery,» about $2,000,000.

The Fiji Islands was constituted a British colony in 1874. The governor is appointed by the crown; he is assisted by an executive council of three; and laws are passed by a legislative council, of which the governor is president. Consult: Cumming, ‹At Home in Fiji›; Smythe, ‹Report on Fiji Islands›; Seeman, ‹Report on the Vegetable Productions and Resources of the Fijian Islands.›

Filament, in botany, the stem of a stamen, supporting the anther. (See FLOWER.) It is usually filiform, but sometimes curiously modified.

Filander, fĭ-lan'dėr, a small kangaroo (*Macropus bruni*), native to New Guinea. It was the first of the kangaroos (q.v.) known to Europeans.

Filangieri, Gaetano, gä-ā-tä'nō fē-län-jā'-rē, Italian political economist: b. Naples 18 Aug. 1752; d. 21 July 1788. His great work. entitled, ‹The Science of Legislation,› notwithstanding it was never completed according to his original design, attracted great attention, from its bold and original views and the liberality of its sentiments. In 1787 he was made a member of the supreme council of finance.

Filarete, Antonio, or **Antonio Averulino,** än-tō'nē-ō ä-vä-roo-lē'nō fē lä rā'tē, called ANTONIO DE FIRENZE: b. Florence about 1400; d. Rome about 1469. He worked under Ghiberti on the famous baptistery gates. Pope Eugene IV. gave him a commission to make the bronze doors for St. Peters in Rome, and he began their execution with assistants about 1439, finishing them 1445, the whole being a feeble imitation of Ghiberti, in bad taste, and entirely lacking in spontaneity. He also made a bronze reduction of the equestrian statue of Marcus Aurelius for the Capitol, now at Dresden, and a mausoleum of the Cardinal of Portugal which disappeared in the 17th century. He is, however, more noted as an architect. Banished from Rome 1449, on the accusation of stealing relics, he entered the service of the Sforza family at Milan, drawing plans for a great hospital in the antique style, only one wing of which he finished. He is the author of a remarkable book, ‹Tratto di Architettura,› written before 1665, a treatise on architecture in 25 volumes, a sort of a verbose and finical romance of which the motive is the construction of an ideal city, called Sforzinda. The undercurrent of the work is a mixture of pagan and Christian philosophy and ethics and an inculcation of didacticism in art.

Filariasis, fil-ạ-rī'ạ-sis, a group of diseases caused by nematode worms (see Nematoda) of the genus *Filaria,* some species of which are parasitic in man and domestic animals. The *Filariæ* are very slender worms, mostly parasitic in subdermal connective tissue and in serous cavities. The developmental history is not entirely elucidated, but they seem to undergo indirect development in the body of some crustacean or insect, species of mosquitoes notably serving as intermediary hosts. Under the term *filariæ sanguinis hominis,* old authorities include the species *F. bancrofti, F. diurna,* and *F. perstans,* the last the parasite to which the sleeping-sickness of the negroes in Africa has been attributed. The most important one of these is *F. bancrofti,* whose numerous embryos enter the blood through the lymphatics, and are present at night in the blood, although usually absent in the daytime. This worm (the male) is about 1½ inches long and from 1-10 to 1-12 of an inch broad. The female is almost twice this size. This parasite may be present in the blood without giving rise to any symptoms, but frequently they block the lymph-channels and produce the conditions of elephantiasis. These forms of lymph-scrotum, and of hæmatochyluria, exist very extensively in Asia and Africa, and within recent years have been found in cities in the southern United States. (For lymph-scrotum and elephantiasis, see Elephantiasis.) In hæmatochyluria the patient, while in excellent health, suddenly passes a large amount of urine of a peculiar whitish or milky-whitish appearance, occasionally bloody; or frequently a fluid resembling chyle, which on settling shows the presence of a blood-clot. This chyluria seems to be intermittent, the patient being well for weeks or months at a time, and then passing large quantities of this modified urine. The embryos are to be found in this urine. Occasionally there are symptoms of uneasiness in the loins and lumbar region, but as a rule the general health is not affected. The treatment is prophylactic solely.

Another form of filariasis is “guinea-worm,” a disease produced by *F. medinensis.* It has been known from time immemorial, and it has been fancied that the plague of fiery serpents which afflicted the children of Israel in the wilderness was really an irruption of such worms. This worm is thought to be bred in the body of some minute aquatic crustacean, as *Cyclops,* and thence to enter its final host, which may be the horse, dog, wildcat, or jackal, as well as man, by the drinking of the water. The form of disease brought about by *F. medinensis* is extremely common among African negroes. In certain provinces of India sometimes nearly one-half the entire population are affected; and it is known in Russia, Turkestan, and Hindustan. The adult female worm usually finds its way into the subcutaneous connective tissue, generally in the lower extremities, especially in the feet or ankle. It has also been found in the arm, eyelid, tongue, perineum, scrotum, and trunk. The presence of the worm is not apparent until it bores its way to the skin. Here it produces a painful swelling which later becomes irritable and sore, and finally there develops a suppurating sinus. The worm may be expelled spontaneously from the sore, or it may be taken out in native fashion. *F. loa* is a similar species, limited in its distribution to the west coast of Africa, where it is not uncommon, and is introduced into man by means of drinking-water. It is an active worm, passing rapidly through the connective tissue, and is very frequently found in the region of the eye, where it bores its way to the conjunctival surface.

Consult: Buck, ‘Reference Hand-Book Medical Sciences’; article, ‘Nematodes’; Manson, ‘Tropical Diseases’; Nuttall, ‘The Rôle of Insects, etc., in the Spread of Parasitic Disease’; (Johns Hopkins Hospital Reports, Vol. VIII., No. 1); Braun, ‘Thierichen Parasiten’ (1902).

Filbert. See Hazlenut.

Fil'des, Samuel Luke, English portrait and genre painter: b. Lancashire 1844. His first Academy picture was ‘Nightfall’ (1868), and since then he has exhibited: ‘The Loosened Team’ (1869); ‘The Empty Chair’ (1871); ‘Fair, Quiet, and Sweet Rest’ (1872); ‘Simpletons’ (1873); ‘Applicants for Admission to a Casual Ward’ (1874); ‘Betty’ (1875); ‘The Widower’ (1876); ‘Playmates’ (1877); ‘The Return of the Penitent’ (1879); ‘The Village Wedding’; ‘Venetian Life’; ‘The Al-fresco Toilette’; ‘The Doctor’ (1892). Several of these, particularly his famed ‘Casual Ward,’ show powers of realism in painting not unlike those of Dickens in fiction, but his later works are more striking from their color-effects. Latterly he has taken a distinguished place as a painter of portraits. His wife is also known as a painter, some of her pictures being: ‘The Cottage Door’ (1877); ‘Peeling Potatoes’ (1878); and ‘A Berkshire Cottage’ (1878).

File-fishes, the fishes of the plectognath family *Monacanthidæ,* so-called from their skins being roughened by minute rough scales. The species are numerous, small, plain in color, herbivorous, lean and not good for food; and are mainly found in the tropical seas. The best known American species is *Alutera schœpfii,* which ranges as far north as Cape Cod, and often shows a decided orange tint upon its olive-gray sides. It reaches a length of 24 inches, as also does its relative the unicorn-fish (*A. scripta*) of the West Indies. A different and much smaller file-fish is the widely distributed “leather-fish” or “fool-fish” (*Monacanthus hispidus*). The Spanish-American fishermen give the name “lija” to all these fishes. These fishes were formerly classified with the trigger-fishes (q.v.) in the family *Balistidæ,* from which they differ conspicuously in having but one erectile dorsal spine. Consult: Gunther, ‘Study of Fishes’ (1859); Goode and Bean, ‘Oceanic Ichthyology’ (1895).

Files and File-making. The file is one of the oldest of hand tools. It is mentioned in the Old Testament scriptures, and probably came into use not very long after man began to work iron. Files were commonly made by hand until about 1850, when machine-made files became general. The first machine proposed for making files was suggested to the French Academy of Sciences in 1702, but it was not until 1812 that the first United States patent on a file-making machine appeared, being taken out by Morris P. Belknap. The files in ordinary uses are made of high-grade steel, from 6 to 14 inches in length being the most common sizes. The pointed end that fits into the wooden handle is called a tang, and the corner formed by the junction of the tang to the body of the file is called the heel. Occasionally they are made with a tang at both ends. The cutting face or faces of a file are formed by the blows of a chisel struck in the file-blank, while the steel is still soft. The closeness and depth of these cuts determines the character of the file, as rough, middle-cut, bastard, second-cut, smooth and dead smooth. When the cuts are crossed so as to form teeth, as in the more common styles, it is a double-cut file. When the spacing between the chisel cuts is varied it is «increment cut.» Files are also named from their cross-section, as round (usually tapered, for enlarging holes), half-round, square or flat. Files for sharpening saws take their names from the kind of saw whose teeth they are shaped to fit, as cross-cut file, cant-saw file, pit-saw file, etc. Dentists' files are made with the handle in the centre, and the filing surface on either end. They are styled bicuspid file, plug file, stump file, etc., according to use. A somewhat similar file, only larger, with bent ends, is called a riffler. The files most commonly used by comb-makers are called slitting and topper files.

Double or checkering files, used by cutlers, gunmakers, etc., are practically two files riveted together, with the cutting teeth so placed that one is half way ahead of the other. These are used to produce the checkered effect peculiar to gunstocks. The files used by watchmakers are exceedingly small, fine and delicate, many of them being of less section than a fine sewing needle, and about half the length. These are named according to the part of a watch or clock on which they are used, as clock-pinion file, balance-wheel file, barrel-hole file, etc. The file proper is not a rubbing or abrading tool, as many non-technical persons suppose, but a true cutting tool, whose teeth point in one direction, and which can be used effectively only in that direction, that is when pushed away from the user. The horseshoer's rubber and the ordinary rasp are kindred tools that perform their function by being rubbed back and forth, but the file is not intended to be used in that way.

In the case of a rasp, a pointed tool is used to indent the surface of the blank, and this raises prominences on the surface that make it useful as a rubbing or rasping tool. In making files, the blank is first stamped or drop-forged from a high-grade steel, inferior or blistered steel being usable only for rubbers. The file-blank in a soft, unannealed condition, is fixed on the reciprocating carriage of a file-making machine, on a surface of lead designed not to injure the cut side of a file when down. The blank is passed slowly forward under a reciprocating chisel, whose blows descend on the blank at distances determined by the speed at which the carriage moves. In a common type of machine the chisel is moved upward by a cam and thrown down to deliver its blow or cut by a powerful spring. The cuts may be deepened by running the blank through the machine a second time. Old files may be recut in the same way. After the cutting, the file is hardened by tempering, and is then ready for use. In using a file the filer takes the handle in his right hand, with the back of the hand downward. He takes a firm hold of the point with the left hand, placing the thumb or ball of the thumb on top; or he may reverse the hands to rest his muscles. He advances the file, that is, pushes it away from him, with a parallel motion, bearing down as the file goes forward, and brings it back without pressure. The learner always has a tendency to see-saw or rock the file, which can be overcome only by practice. Unless the file is kept level, the surface cannot be cut down to a level. The use of the file in machine work has been much superseded during recent years by the introduction of the emery wheel, operated by power, against which the work is held and ground down with much reduced labor. But the emery wheel will not accomplish a great many things that can be done with the hand file, hence its manufacture is not endangered by the increased use of the wheel. See HARDWARE TRADE IN AMERICA.

Filibusters (Sp. corrupted from Dutch *vrijbueter,* our «freebooter»), originally the West Indian buccaneers; in the 19th century and now, any lawless band who attack a foreign country not at war with their own. Especially, the United States companies who used to make descents on the Spanish-American states or colonies, either from personal ambition tempted by their anarchic state, or to annex them to the Union as slave territory. Burr's Southwestern Empire was to have been the fruit of the most stupendous filibustering expedition of modern times (1806-7); Texas actually was the fruit of another, disguised as colonization. The later ones, 1850-60, were all of the second type. One of their chief promoters was J. A. Quitman of Mississippi, and in 1850 he aided the adventurer Lopez to fit out abortive expeditions to Cuba, for which both companions were arrested but acquitted. In August 1851 Lopez sailed from New Orleans with 500 men, and landed in Cuba, but the Cubans would not rise. Lopez's force was routed and scattered to the mountains, and he was caught and garroted. Pierce's proclamation of 31 May 1854 showed that the government would tolerate no more of this against Spanish territory; Mexico was too strong to attack privately; and Central America being the only available North American section left, William Walker (q. v.) raised a California company in 1855 and assailed Nicaragua. He defeated the government troops, captured Granada the capital, executed his antagonists and set up a government recognized by Pierce, which re-established slavery and invited Southern immigration. But his performances raised an insurrection, helped by other Central American states, and by a United States corporation he had foolishly plundered, and he was driven out in April 1857. On a second expedition in November, he was seized and brought back; a third was stopped by the government; with a fourth he landed in Honduras 27 June 1860, and was defeated, court-martialed, and shot. There was no more filibustering till after the War; but from 1868 till the Spanish war of 1898 there was more or less, in co-operation with the Cubans. The most noted case was of the Virginius (q.v) in 1873, which the Spanish captured and shot the commander, Fry, with 36 of the crew.

Filibustering enterprises when they meet with failure entail loss of life and of liberty, as well as denunciation from the nation in whose aid they were organized, whereas in case of success filibusters are acclaimed as national heroes.

Among modern filibusters may be mentioned Dr. Jameson (q.v.) and his raiders in South Africa. Had Jameson and his followers been successful in overthrowing the Boer government in 1895, they would doubtless have been hailed as heroes. As it was, their lamentable failure left the English government no alternative but to denounce and treat them as filibusters. After having been condemned to death and to terms of imprisonment by the Boer government, they were eventually turned over to the English authorities for punishment, and taken to trial in London, were convicted and fined and deprived of their liberty.

Perhaps the most noted filibuster in modern times was the Italian patriot Garibaldi (q.v.). In 1862 the Italian government was compelled to arrest him at Aspromonte in order to prevent him from carrying out his project of an armed expedition against the papal states, with which King Victor Emmanuel was then at peace, and in 1867, having managed to evade the watchfulness of the Italian authorities, he actually invaded the papal states, defeating the Pope's troops at Monte Rotonda, being afterward himself routed at Mentana by the French military force that occupied Rome. For this violation of the Italian laws on the subject of filibustering he was arrested by the Italian government after his retreat from Mentana and imprisoned for a time in the fortress of Alessandria. Other modern filibusters were M. De Mayrena, the Parisian clubman and counterpart of Alphonse Daudet's 'Tartarin de Tarascon,' who established himself as King of the Sedangs, and who died as such in his palace in the island of Tio-Man, in the Indo-China Seas, and the Franco-American soldier of fortune and Parisian journalist «Baron» Harden Hickey, who figured for a time as prince and ruler of the island of Trinidad, on the Brazilian coast. See BUCCANEERS; FREEBOOTER; PIRATE.

Filicaia, Vincenzo do, vēn-chen'tzō dā fē-lē-cä'yä, Italian lyric poet: b. Florence 30 Dec. 1642; d. there 25 Sept. 1707. Some of his patriotic sonnets are famous; but his verse, though not without beauty and spirit, is disfigured by the rhetorical tricks and false conceits of the period. An edition of his works appeared at Florence in 1864.

Filigree Glass, one of the kinds of ornamental glass for which Venice was formerly celebrated, the manufacture of which has been recently revived. Small filigree canes of white and colored enamels are drawn, made of the required lengths, arranged in clusters in a cylindrical mold of the required shape, and then fused together. The canes are then aggregated by flint glass at a welding heat, and the mass twisted if a spiral ornament is desired. Vases or other objects are made of ornamental masses of this glass, blown in the usual manner.

Filigree Work, a kind of ornamental work in fine gold or silver wire, wrought delicately, and generally more or less varied by the intermixture of grains or small beads of the metal, and of bands, strips, or bars, to give greater strength. An immense variety of patterns can be produced, the wire being made to assume the forms of arabesques, leaf-work, etc., the parts being joined together by gold or silver solder with the use of the blow-pipe. Working in filigree is one of the most ancient and widely spread arts. Specimens have been obtained from ancient Egyptian, Greek, and Etruscan tombs, and in various parts of Asia articles in filigree have been made from the remotest times down to the present day, as in China and India. In the latter country the wire-work bears much resemblance to the old Greek filigree. An exquisite frosted effect marks the surface of some of the Greek work. After the method of producing this frosting had been lost it was revived or rediscovered. Greek filigree work was especially fine during the 4th or 5th centuries. Among the Celts, Anglo-Saxons, and Scandinavians, excellent specimens of filigree were early produced, being employed in such articles as bracelets, ear-rings, brooches, etc. Old Irish filigree work was of especially high quality, particularly during the 10th and 11th centuries. The Byzantine workers in filigree were also famous, and the influence of their work was widely felt in Europe during the Middle Ages, books, reliquaries, etc., being ornamented in this manner. At Venice, and in several of the French and German towns, elegant specimens of this delicate art were manufactured as early as the 12th century. In the 17th century the art was carried to its highest perfection in Italy. The Italian peasantry, as well as those of other countries, still produce filigree work for personal adornment; and the Malta filigree is world-famous. The Chinese filigree, made mostly of silver, has not the extraordinary delicacy of some of the Malay and other eastern work. Filigree objects of great beauty of workmanship are produced in the United States.

Filioque, fĭl-ĭ-ō'kwē («and from the Son»), a phrase inserted in the creed of Nicæa, or rather the Nicæo-Constantinopolitan creed, as an expression of the Catholic Church's teaching concerning the relation of the Third Person of the Holy Trinity to the Father and the Son. Before the insertion of *Filioque* that creed, in its Latin version, contained these words, *Et in Spiritum Sanctum . . . . qui ex patre procedit* (and in the Holy Ghost . . . . who proceeds from the Father). The addition of *Filioque* (and from the Son) after *procedit,* appears to have been made first in the churches of Spain as early as 447; it was commanded by the Synod of Toledo 653. But the addition was not adopted or approved by the Roman Church till as late as the 9th century; this, not because the *Filioque* imported into the creed a doctrine not accepted in that Church, but simply because it was not considered wise to add anything to the ancient formula of Catholic belief. The Greek Church never accepted the addition till in the Council of Florence, 1439, the large number of Greek bishops and metropolitans, with the patriarch of Constantinople at their head, who attended that council, solemnly subscribed to the Nicæo-Constantinopolitan *symbolum* as amended by insertion of *Filioque,* and thus effected, as they believed and as the Latin bishops believed, a reunion of the Eastern and Western Churches. At the same time the bishops representing the Latin Church in the same council, signed a solemn declaration that the formula which had been used by the Greeks, «proceeding from the Father *through* the Son» was thoroughly orthodox and consonant with the *Filioque*. The Greek Church itself did not ratify the action of its representatives in the Florence council until 1452, when they were acknowledged and promulgated in the Church of St. Sophia at Constantinople; but in a council held by the Greeks in 1472 the acts of the council of Florence were formally repudiated, and the act of re-union canceled. The two Churches have ever since been separate.

Filipino, fĭl-ĭ-pē′-nō, a native of the Philippine Islands. The Filipinos form a very mixed population, and seem to represent almost every type of the human race. Some of the tribes have become more or less civilized, others live in the same barbarism as prevailed before the Spanish occupation. In the make-up of the composite Filipino, the darker substratum has been supplied by the Negrito, the Papuan and the African negro. A copper tint has been added by the Malay and Polynesian. This infusion of fierce blood has given to the islanders their fighting qualities. There exist among them certain arts of life, and a skin of a paler hue, inherited from Japanese, Chinese and Cambodian sources. Hamite, Semite and Aryan are each said by ethnologists to contribute some elements to the life, physical, intellectual, and religious, of this strange people, and two centuries of uninterrupted commerce between the archipelago and South America has introduced also a strain of American Indian blood into the Filipino race.

When we come to analyze the tribes, as far as they are at present known to scientific men, it appears that the Indios, the more or less civilized natives of the archipelago, divide themselves naturally into four groups, namely, Tagals, Vicols, Visayas, and Llocanes. The Tagals are palpably the most advanced in the arts of life, and number about a million and a half. Most of them live in the island of Luzon, preferring to settle in the low-lying plains, or near streams and on the seacoast. From Luzon they extend southward, in scattered groups, through Mindoro, Marinduque, and smaller islands farther south. They cultivate the soil, raise large quantities of rice, and are bold and skilful fishermen; and this active industrious life shows itself in their vigorous physique, and powers of endurance. The Tagalog language is more widely spoken than any other Filipino dialect. The Llocanes occupy territory in the extreme northern peninsula of Luzon. They form but a small tribe, and seem to be distinguished from the Tagals merely by the dialect they use. The island of Visaya is wholly occupied by the tribe from which it takes its name, and the Visayas are said to number some two millions and a half and to speak a distinct language which separates them from the other Malayan races of the archipelago. The Vicols number about 400,000 and are scattered over the Camarines peninsula, and occupy also the islands of Catanduanes, Burias, Ticao, and half of the Masbate. In physical type and habits of life they largely resemble the Tagals. The Sulu chain of islands, which stretches between Mindanao and North Borneo, is peopled by the Moros, who are also found on the southwest coasts of Mindanao, and Balabec, as well as on the south coast of Palawan, or Paragua Island. Their original seat was undoubtedly Borneo, from which they have derived their Mohammedan faith, and most of their social usages. They have nothing in common with the peoples farther north and have stoutly resisted all attempts to Christianize them. They were once the fiercest pirates of the archipelago and lived by ravage and robbery. The natives of the northern islands, upon whom they once preyed, as they learned from the Spaniards the use of firearms, and modern methods of warfare, were able successfully to repel the raids of the Moros, whose primitive weapons could not cope with repeating rifles and Gatling guns.

As the mountains are the last refuge of liberty in a conquered country, so also are they the last lurking place of savagery and barbarism. The interior of Luzon and several other islands is mountainous and uncultivated; here lurk the savage tribes whom two hundred years of Spanish rule have failed to civilize or even subdue. These are reckoned at half a million souls, have many languages and dialects, and are in greatest force among the mountain fastnesses of central Mindanao. While some of these tribes are peaceful and inclined to commerce and industry, a large section shows the warlike spirit that urges them to live on rapine. The Negritos, or Little Negroes, dwell in the higher ranges of Luzon and Negro; they are black in skin, and dwarfish in stature; they are evidently a degenerate race, doomed to early extinction.

The Spaniards appear to have done very little to investigate the antiquities of the Filipino races. There is a vast field of exploration open to ethnologists and archæologists in this remarkable archipelago, which possesses a literature of its own in poetry and folk-lore, and has derived from Malay and Indian invaders such arts as metallurgy and weaving, in both of which arts many of the tribes are exceedingly expert. The ethnologists of the Smithsonian Institution have already turned their attention in this direction, and the United States Treasury Department is putting every possible facility in the way of those who are trying to unravel the story of the savage navigators who first cruised in the channels of the Philippine archipelago. See PHILIPPINES.

Filix. See FERN, MALE.

Fillans, James, Scottish sculptor: b. Wilsontown, Lanarkshire, 27 March 1808; d. Glasgow 12 Sept. 1852. After acquiring some local celebrity in Paisley by his portrait-busts, he proceeded to Glasgow. He subsequently visited Paris to improve himself in his art, and in 1836 took up his abode in London. A life-size group in marble, the 'Blind Teaching the Blind,' was exhibited by him in Glasgow, and produced a great sensation. Other admirable works of his are: 'The Boy and Fawn,' a statue of Sir James Shaw (in Kilmarnock), and a bust of Prof. Wilson.

Fillet (1) In ordinary language, a narrow band of metal, linen, or ribbon worn round the head. Sacred fillets were those worn by the priests of Greece and Rome. Also portions of meat or fish removed from the bone and served either flat or rolled together and tied. (2) In architecture, a small flat face or band used principally between moldings to separate them from each other in classical architecture; in the Gothic, Early English, or decorated styles of architecture, it is also used on larger moldings and shafts. Also the projection between the

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flutes of a column. (3) In anatomy, that part of the sensory nervous tract lying in its passage from the decussation of the sensory columns to the internal capsule. Disease or disturbance of the fillet usually results in a form of generalized anæsthesia. See APOPLEXY; HEMIANÆSTHESIA; HEMIPLEGIA.

Fill'more, Millard, American statesman, 13th President of the United States: b. Summer Hill, Cayuga County, N. Y., 7 Feb. 1800; d. Buffalo 8 March 1874. He studied law in his native county and in 1821 removed to Erie County, and pursued his legal studies in the city of Buffalo. In 1827 he was admitted to the bar and in 1829 commenced his political career as a representative of Erie County in the State legislature, and in 1832 he was elected to the Congressional House of Representatives. For a number of years he alternated between political life and the exclusive practice of his profession, rising steadily in the general estimation as an able lawyer and consistent and promising leader of the Whig party. Elected in 1847 comptroller of the State of New York, he enjoyed in 1848 the still higher honor of being elected by his party as Vice-President of the United States. The new President, Gen. Taylor, entered on his office in March 1849, and on his sudden death in July 1850, Fillmore became, in virtue of his office, President of the United States. He was installed in the White House at what was, in several respects, a critical moment in the history of the Union. It was the era of the Lopez expedition against Cuba; and of a more than usual bitterness in the relations between North and South on the slavery question. Fillmore made Daniel Webster his secretary of state, an appointment which strengthened and popularized his administration. President Fillmore's messages favored the fugitive slave law, and recommended a protective, but not a prohibitory, tariff. Under his presidency California was admitted as a new State into the Union. He was the candidate of the American party for the presidency in 1856, but he received a very small minority of votes. After his retirement from public life he resided in Buffalo, N. Y.

Film, a transparent, flexible substance used as a substitute for glass plates for portable photographic work. It consists of a strip of celluloid which is treated with a sensitized coating, the same as is used on plates (see PHOTOGRAPHY). This strip is wound on rollers, and so placed in the camera that it may be unwound from one roller, exposed, and rolled on another. The film is made from liquid cellulose, formed by dissolving gun-cotton in amylacetate, or other solvent. It can be made in any length desired by stripping the liquid from a polished surface by a revolving wheel.

Fil'mer, SIR **Robert,** English political writer of the Caroline age: d. 1653. He was educated at Trinity College, Cambridge, and became an active Royalist. He wrote in advocacy of the divine right of kings, and was knighted by Charles I. His uncompromising defense of absolution made him a marked man, and his views were strongly controverted by Algernon Sidney and Locke. Undoubtedly his most important work is 'Patriarcha; or the Natural Power of Kings' (1680).

Filmy Ferns. See *Filicales* (7), under FERNS AND FERN ALLIES.

Filon, Auguste, ō-goost fē-lôṅ, French historian: b. Paris, France, 7 June 1800; d. there 1 Dec. 1875. A commanding point of view and alluring style are conspicuous throughout his 'Comparative History of France and England' (1832); 'The Spiritual Power in its Relations with the State' (1844); 'History of the Roman Senate' (1850); 'History of the Athenian Democracy' (1854); and several other important historical works.

Filon, Pierre Marie Augustin, pēār mā-rē ō-goo-stăṅ fē-lôṅ, French critic: b. 1841. He is the son of A. Filon (q.v.), and was tutor of the Prince Imperial 1867–70. He is the literary editor of the 'Revue Bleu' and is the author of 'Guy Paton' (1862); 'Les mariages de Londres' (1875); 'Histoire de la littérature anglaise' (1883); 'Prosper Mérimée' (1894); 'English Profiles.'

Filter and **Filtration.** In chemical technology the process of filtration consists in passing a liquid through a porous or fibrous solid, for the purpose of removing certain elements of the liquid. In chemical analysis in the wet way, filtration is resorted to continually, in order to separate precipitates from the liquids in which they are suspended. The filters used for this purpose consist of sheets of a special kind of bibulous paper, which should consist of almost absolutely pure cellulose, so that it will leave practically no ash when burned. The precipitate, when it has all been deposited upon the filter paper, and has been thoroughly washed, is transferred, together with the paper, to a platinum crucible, in which it is heated until the paper has become entirely burned away, and nothing is left but the precipitate that is to be weighed. Gelatinous precipitates filter very slowly, and for this reason it is usual for chemists to pay careful attention to such little details of manipulation as tend to cause the precipitate to take as granular a form as possible, so that the filtration may be performed rapidly. When the object of the filtration is merely to remove solid particles that are suspended in a liquid, and a quantitative estimate of these solids is not desired other materials than paper are often used as filtering media with advantage. Thus the liquid may be passed through plugs of asbestos fibres, or of glass wool, these particular substances being very useful when the liquid to be filtered is of a corrosive nature, like a strong mineral acid. Filtration through porous plugs is often hastened by creating a partial vacuum on that side of the plug toward which it is desired that the liquid shall flow, and aspirators, or special filter pumps, are constructed for this purpose. When it is desired to remove such minute bodies as bacteria from a liquid in which they are suspended, it is common to pass the liquid through a solid septum of unglazed porcelain, though it has been found that nearly all such bodies can be removed by filtration through a sufficiently thick mass of sand. Cities which must obtain their drinking water from rivers polluted by sewage from other towns and cities are now supplied with water of very good quality by filtering the river water through beds of sand some feet in thickness, and statistics, in such cases, have shown that the installation of such filtration plants is often attended by an almost incredible decrease in the death rate from typhoid fever and other analogous diseases. See WATER PURIFICATION.

Filth-disease, an old term of little scientific meaning at the present time. Modern theories of disease predicate definite infecting agents. Dirt and filth of themselves are not necessarily associated with any known disease. If perchance collections of filth become contaminated with the dejecta of people suffering from infectious diseases, then the filth, through the agency of flies or other insects, may become a source of infection. See CONTAGION; HYGIENE; INFECTION.

Fin de Siecle, făṅ dē sî-ā′-kl («the end of the century»), supposed to particularly mark the close of the 19th century, regarded as a period of emancipation from the traditional moral and social state of disorder.

Finance relates to the revenues and expenditures, the pecuniary resources and disbursements of a nation, state, corporation, or individual. It is a word of ancient usage, introduced into England through Normandy, and derived, according to Littré, from an old and now obsolete French verb, *finer*, which was used, in its restricted sense, to signify arriving at a final settlement by payment of money, or finding the ways and means thereto. In Berner's 'Froissart' 1523 occurs the word finance: «So he was put to his fynanse to pay XXII. thousande franks of France and the companyons of the Englysshe garysons in Champaigne payed the sayd ransaume.»

The prosperity of nations has often depended on the ability, tact and wisdom of their financial ministers. In France, Colbert and Necker; in England, Godolphin and Peel; in America, Hamilton, Gallatin, and Chase have been regarded as showing eminent ability in finance. The principal object in the study of finance is to arrive at the fundamental principles that should govern the taxes, customs, and income, the credit, loans, and currency, and all that is connected with the revenues and necessary expenditures of a people. This may perhaps be best obtained from the experience of the past as told in history. There we find that practical and sound finance must have due regard to the laws of trade,— which like the laws of nature are never opposed or disregarded with impunity,— that it must insist upon the faithful execution of contracts, and see that taxes are never allowed to injure the source of income. Hume wrote that «one of the chief causes of the destruction of the Roman empire was the alteration which Constantine introduced into the finances, by substituting an universal poll-tax in lieu of almost all the tithes, customs, and excises which formerly composed the revenues of the empire. The people in all the provinces were so oppressed by the publicans (tax-gatherers) that they were glad to take refuge under the conquering arms of the barbarians.»

Colonial Finance.— The colonial history of America is replete with interesting problems and experiments in finance. To find ways and means to support the necessary expenses of their respective governments and to carry on the Indian wars was perplexing to all the colonies. Taxation was not a right of sovereignty. The early settlers held and handed down the principle (a principle which Lord Chatham in his speeches in Parliament stated had long been acknowledged in England) that taxes are a voluntary donation from the people to the government. The early settlers declared emphatically that there should be no titles of nobility, no prerogatives, that no man's property should be taken for the public use without his being indemnified. They claimed that every man should bear his portion of the public expenses, but if expenses were incurred for purposes in which the individual and his property were not benefited, for such he could not be taxed. Money was scarce, trade was frequently carried on by barter and it is not, therefore, surprising that the colonies resorted to the issue of paper money. Massachusetts was the first to set the example and the other colonies soon followed, with the result that whatever coins existed in the country disappeared, in obedience to the rule that the poorer currency drives out the richer. Another instructive lesson in the financial history of the colonies was the legislative attempts to fix the prices at which commodities should be bought and sold and labor employed. These regulations were in conflict with the laws of trade and proved futile or disastrous.

Finances of the Revolution.—«The first financial operation of what was to become the United States,» was a loan of £6,000 obtained in 1775 by the Continental Congress «for the use of America.» Franklin (q.v.) urged that Congress should continue to raise money by loans rather than resort to the issue of paper currency, but the majority of the delegates thought otherwise. «Do you think, gentlemen,» cried one, «that I will consent to load my constituents with taxes, when we can send to our printer and get a wagon-load of money, one quire of which will pay for the whole?» The first issue of paper was $3,000,000, and in December 1775 $3,000,000 more were ordered. The certificates or notes were to be redeemed by the States during the four years beginning with 1783.

In December 1777 John Adams (q.v.) wrote to Elbridge Gerry (q.v.), «The man who lent another £100 in gold four years ago and is paid now in paper cannot purchase with it one quarter part in pork, beef, or land of what he could when he lent the gold.» Two years later he could not have purchased one thirty-eighth part.

The rapid decline in the value of this currency caused great distress and suffering, reduced many persons from affluence to poverty, and is said to have injuriously affected the moral ideas of the people. After declining from 100 to 1, it ceased in 1781 to pass as money and «barber shops were papered in jest with the bills.» The amount of this paper money issued by Congress was stated by Franklin to have been $200,000,000, but Dewey in his recent 'History of the Financial History of the United States' says the total amount issued exceeded $240,000,000. As the bills had been poorly printed, they were easily counterfeited and the counterfeits were so numerous and perfect (some, it is alleged, were manufactured in England) that the redemption of the genuine notes would have been difficult even if the means to redeem them existed.

In the meantime, after other attempts to raise money by appeals to the States and confiscation of the property of Tories with small results, Congress again resorted to loans. In 1783, the loans of the United States amounted to

$42,000,000, of which $7,885,085 were obtained abroad. To meet the interest on foreign loans, money was borrowed in Europe. Home creditors at that time received no interest, and some sold their claims at one tenth of the face value. After the adoption of the Federal Constitution these claims were paid at their full face value by Hamilton.

On 20 Feb. 1781, Robert Morris (q.v.) was made superintendent of finance. He took the office with the stipulation that he should have full power to remove all whom he thought unfit for their positions in the Treasury Department. He began his reform by curtailing expenses and opposing unnecessary expenditures. He introduced system and order, improved the foreign credit, established a bank that was of great service to the government, and when all other sources of income failed, he used his own credit. He remained in office about three years, and for five years thereafter chaos is said to have reigned in the treasury. A decade had not passed after America's experience with continental paper money before France began the issue of *assignats* which had results even more disastrous.

On the organization of the Federal government in 1789, Alexander Hamilton (q.v.) was appointed secretary of the treasury. The public credit was at that time in the lowest state of depression; its fiscal resources were unknown, as no statistical account of the resources of the country had been attempted. He organized the Treasury Department, with a treasurer, comptroller, register, and auditor, and introduced the system of warrants which exists to-day. When he made his first report to Congress and inquired whether he should make it verbally or in writing, they replied that they would receive it in writing, and so all secretaries have submitted written reports. His official reports are considered masterpieces. He established the public credit on a firm basis and retired, after being secretary somewhat more than five years, with the reputation of being one of the greatest financiers of the age.

Among the salient points in American finance is the administration of Albert Gallatin (q.v.). To his suggestion, when he was a member of the House, was due the first formation of the Committee of Ways and Means. Appointed secretary of the treasury by Jefferson in 1801 and continued in office by Madison in 1809, he served the long period of 12 years. He was zealous in the cause of economy and reduced the public debt from $83,000,000 in 1801 to about $50,000,000 when he retired in April 1813, and he had provided funds for the purchase of Louisiana and for the early expenses of the War of 1812. He held that expenses incurred for war should be paid from loans and that taxes should not be imposed except to meet the annual expenses of the government on a peace basis and interest on the public debt, and that the debt would gradually be paid from the surplus revenue caused by the development and growth of the country.

In 1835 the United States stood in the remarkable position of a nation without debt. In that and the following year, nearly $40,000,000 came into the treasury from the sales of public lands. Congress voted to distribute to the States all the surplus over $5,000,000. About $28,000,000 were distributed, but before the balance was paid a severe panic spread over the country; the banks, including those that held the government deposits, suspended, and the government found itself on the verge of bankruptcy. The law authorizing further distribution was repealed.

The law establishing the independent treasury, often called the sub-treasury, was enacted July 1840 and was repealed 13 Aug. 1841. August 1846 the law was re-enacted. The independent treasury now exists with an assistant treasurer in Washington, New York, Boston, Philadelphia, New Orleans, Charleston, St. Louis, Chicago, and San Francisco.

During the panics of 1857 the United States government, having its money in the independent treasury, was able to meet all its obligations promptly and has been enabled in later panics to afford relief to the community by purchase of United States bonds or prepayment of interest. Although sound finance seems to require that the government should interfere the least possible in the affairs and business of the people and that it should not assume paternal functions, there are times when its brief assistance appears justifiable.

Finances of the Civil War.— Salmon P. Chase (q.v.) became secretary of the treasury 7 March 1861. In the beginning it was thought that the War would be of short duration, and when Congress was convened in special session in July 1861 attention was given to obtaining money by loans, rather than by any great increase of taxation. Accordingly, Congress authorized a loan of $250,000,000 in 3-year 7-30 treasury notes and in 20-year bonds with interest not to exceed 7 per cent, or in lieu of a portion of said loan the secretary was authorized to pay salaries or other debts or exchange for coin, non-interest bearing treasury notes payable on demand and receivable for all public dues, to the extent of $50,000,000. Clothed with this authority, Mr. Chase invited representatives from the banks of New York, Boston, and Philadelphia to meet him in New York. The result of the conference was an agreement by the banks of the three cities to advance to the government at once, or as wanted, on the secretary's drafts in favor of the assistant treasurer, $50,000,000 in consideration of which the secretary agreed to appeal to the people for a subscription to a national loan on 3-year notes bearing 7-30 per cent interest, and to pay over the proceeds of the subscriptions to the banks and to make good any deficiency by delivering to them 7-30 notes. The agreement was faithfully fulfilled. Books of subscription to the national loan were opened in all parts of the loyal States and the people responded with enthusiasm and alacrity. About $45,000,000 were thus subscribed and paid to the banks and the remainder was made good by the delivery of the promised 7-30s. This operation enabled the banks to make a second advance of $50,000,000 nearly on the same terms. They attempted to furnish a third $50,000,000 in exchange for the 20-year bonds, but the market price of the bonds declined, the banks were unable to sell them, and 30 Dec. 1861, the banks of New York suspended specie payments and their example was followed throughout the country. On 25 Feb. 1862, Congress authorized the issue of $150,000,000 of legal tender notes. The measure met with great opposition; bankers and members of the boards of trade of different cities hastened to Washington to use their influence against it, and the press very generally denounced it. But the suspension of the banks made it certain that the government could no longer obtain coin on loans. Secretary Chase had wished to avoid the necessity of making notes of any kind a legal tender and with that object had proposed to the banks several plans including a national banking system; but they were slow to give their unanimous consent. As the secretary had not, in any report made by him to Congress, suggested the expediency of making the notes of the United States legal tender, some of the members of the House desired to be assured of his views before voting on the measure; and the Committee of Ways and Means formally asked his opinion as to the necessity and propriety of the immediate passage of the bill. Mr. Chase replied:

> It is not unknown to the Committee that I have felt nor do I wish to conceal that I now feel a great aversion to making anything but coin a legal tender in payment of debts. It has been my anxious wish to avoid the necessity of said legislation. It is, however, at present impossible, in consequence of the large expenditures entailed by the war and the suspension of the banks, to procure sufficient coin for disbursements, and it has therefore become indispensably necessary that we should resort to the issue of United States notes. The making them a legal tender might, however, still be avoided if the willingness manifested by the people generally, by railroad companies and by many of the banking institutions to receive them and pay them as money in all transactions were absolutely or practically universal, but unfortunately there are some persons and some institutions which refuse to receive and pay them and whose action tends not merely to the unnecessary depreciation of the notes, but to establish discriminations in business against those who, in this matter, give a cordial support to the government, and in favor of those who do not. Such discriminations should if possible be prevented and the provision making the notes a legal tender, in a great measure at least, prevents it by putting all citizens in this respect on the same level both of rights and duties.

After the reading of this letter in the House the bill was passed. On 11 July 1862 Congress authorized another issue of $150,000,000, and by acts of 17 January and 3 March 1863 a third issue of $150,000,000, making a total issue of $450,000,000. The issue of these legal tender notes was followed by a great rise in the prices of food and other commodities. Gold went to a premium and fluctuated from day to day. In 1862 $100 in gold sold for $130 in paper, and in 1863 the variations were between $125 and $160. On 17 June 1864 a bill was enacted to prevent speculation in gold. It declared unlawful any contract to purchase or sell gold to be delivered on any day subsequent to that on which the contract was made, or any contract for sale and delivery of gold coin or bullion, of which the person making such contract was not in actual possession at time of making the contract. This legislation, designed to reduce, had the effect of advancing the price of gold. On 17 June gold was selling at $195, by 30 June gold was $250, and 2 July, 15 days after its passage, the law was repealed.

California alone of the loyal States continued throughout the War on a gold basis, her people refusing to accept paper money.

In 1863 the National Bank Act was passed with the beneficial results of establishing a uniform bank currency in place of the currency of State banks, which often circulated with difficulty and at a discount outside the limits of their respective States. As the act required the national banks to hold a certain amount of United States bonds and to pledge United States bonds at Washington as security for the bank circulation, it made an extra demand for the bonds. See BANKS AND BANKING.

In the creation of debt by loans or otherwise, Mr. Chase kept four objects steadily in view: (1) moderate interest; (2) general distribution; (3) future controllability; (4) incidental utility.

At the close of the war Secretary Hugh McCulloch (q.v.) urged the resumption of specie payments, holding that the legal tender acts were only a war measure. In April 1866 Congress authorized the retirement of $10,000,000 within six months, and not more than $4,000,000 any one month thereafter,— $44,000,000 were thus retired when further reduction was suspended by act of 4 Feb. 1868. The legal tender notes thus reduced to $356,000,000 were increased in 1873–4 by Secretary Richardson, who issued $26,000,000 in purchase of bonds. In 1874 Congress passed a bill to increase the amount of legal tender notes to $400,000,000, but President Grant (q.v.) vetoed the bill in his memorable message of 22 April 1874.

Silver Currency.— In the meantime the product of silver mines in the United States was increasing at a remarkable rate. In 1861 the annual product, at its coining value, was $2,000,000; in 1864, $11,000,000; in 1871, $26,000,000; in 1875, $30,000,000; in 1910 it was $30,000,000. The act of 28 Feb. 1878, which became a law notwithstanding the President's veto, authorized the coinage of standard silver dollars and made them legal tender at their nominal value for all debts and dues, public and private, except where otherwise expressly stipulated in the contract, and authorized the holders of silver dollars to deposit the same in sums not less than 10 dollars and to receive therefor silver certificates which shall be receivable for customs, taxes, and all public dues, and when so received may be reissued. The secretary was also directed to purchase silver bullion at the market price, not less than $2,000,000 nor more than $4,000,000 per month and coin the same into silver dollars.

Four years later in 1882 in order to increase the output and circulation of silver dollars, Congress authorized the secretary of the treasury to transport, free of charge, silver coins when requested to do so, provided an equal amount in coin or currency was deposited in the treasury by the applicant.

Under the act of 1878 and prior to 14 July 1890 the

Total amount of bullion purchased was....	$308,199,162
Total dollars coined....................	378,166,793
Seigniorage or gain to U. S. government..	$ 69,967,631

The act of 14 July 1890 authorized the purchase of silver bullion at its market price, at the rate of 4,500,000 ounces per month to be paid for by legal tender treasury notes redeemable "in coin." Said notes when redeemed to be reissued. Upon the demand of the holder of any of these treasury notes, the secretary was directed to redeem these notes in gold or silver at his discretion "it being," so the act reads, "the established policy of the United States to maintain the two metals on a parity with each other upon the present legal ratio or such ratio as may be provided by law."

During the 14 years ended December 1892 $450,000,000 new paper currency ($325,000,000 of silver certificates and $116,000,000 of treasury certificates) had been put in circulation. Under this great volume of currency, the year 1893 commenced with great expectations of increasing business prosperity, but in the spring doubts and distrust spread over the country, people began to hoard gold and one of the greatest panics of the century followed.

To meet the expenditures of the war with Spain in 1898 a loan of $400,000,000 in 3 per cent bonds was authorized by act of 13 June 1898, and a long list of stamp and special taxes imposed, including for the first time in Federal taxation the very un-American tax on legacies.

Of the 3 per cents $100,000,000 were at once issued as a popular loan, directly to the people, preference being given to subscribers of small amounts, $500 or less. The loan was largely over-subscribed and the bonds went immediately to a premium. The war lasted only four months.

The important act 14 March 1900, enacted that the gold dollar of 25.8 grains of gold, 0.9 fine, shall be the standard unit of value, and all forms of money issued or coined by the United States shall be maintained at a parity of value with the standard, and it shall be the duty of the secretary of the treasury to maintain such parity; it also provided that the United States notes and treasury notes issued under act of 14 July 1890 shall be redeemed in gold coin, and authorized a reserve fund of $150,000,000 in gold coin and bullion to be used only for redemption purposes.

The accumulation of moneys in the treasury was in 1903 a matter of much concern to the administration and the secretary, under the sanction of law, made a large number of the national banks throughout the country United States depositaries, and there were in August 1903 on deposit in these banks $117,000,000 of United States funds.

The revenues of the government of the United States from all sources (by warrants) for the fiscal year ended 30 June 1910 were:

From internal revenue	$289,933,519
From customs	333,683,445
From profits on coinage, bullion deposits, etc	4,119,809
From revenues of the District of Columbia	6,853,981
From sales of public lands	6,355,797
From fees — consular, letters patent, and lands	5,741,469
From navy pension, navy hospital, clothing, and deposit funds	1,057,215
From forest reserve fund, July, 1910	2,093,006
From tax on circulation of national banks	3,333,011
From payment of interest by Pacific railways	10,063
From sales of government property	1,664,903
From customs fees, fines, penalties, etc	728,575
From immigrant fund	4,179,148
From miscellaneous	$6,244,568
From Soldiers' Home permanent fund	811,163
From Panama canal	30,731,000
From sales of ordnance material and powder	278,482
From pension funds	112,443
From sale of naval vessels and army transports	18,438
From sale of lands and buildings	272,422
From tax on seal skins	153,375
From trust funds, Department of State	394,341
From depredations on public lands	262,697
From public debt	31,674,282
From Postal Service	224,128,658
Total receipts	$931,314,665

The expenditures for the same period were in part:

For the executive, including foreign intercourse, public buildings, collecting the revenues, District of Columbia, executive proper, and other miscellaneous expenses	$355,345,595
For the military establishment, including rivers and harbors, forts, arsenals seacoast defenses, and expenses of the war with Spain and in the Philippines	158,172,957
For the naval establishment, including construction of new vessels, machinery, armament, equipment, improvement at navy-yards, and expenses of the war with Spain and in the Philippines	123,974,208
For Indian Service	18,504,131
For pensions	160,696,416
For interest on the public debt	21,342,979
For deficiency in postal revenues	8,495,612
For Postal Service	224,128,658
The total expenditures of the Government for all purposes in 1910 was	$950,795,418
The Congressional appropriations for 1911 aggregate	$663,725,795

The changes in the amounts of the several kinds of money of the United States outside the treasury between 1 July 1909 and 1 Nov. 1910 are shown in the table below.

The estimated population of the United States 1 July 1900 was 76,303,000 and the per capita supply of money outside the treasury was $26.93. The estimated population and the per capita supply of money 1 July 1910 were 90,000,000 and $34.33, respectively.

The finance reports of the Treasury Department show receipts and expenditures from the beginning of the government to the present time, and contain much information. From them it appears that the expenditures for the navy did not annually amount to $10,000,000 until 1853. In 1910 they were $124,000,000. The most striking feature in the national expenditures during recent years has been the pensions. In 1875, ten years after the close of the Civil War, the amount of pensions was $29,450,000. The increase was steady till 1890, when they amounted to $87,000,000. In that year a new «dependent pension» law was enacted and they jumped to $107,000,000. In 1909 they reached their highest

THE CHANGES IN THE AMOUNTS OF THE SEVERAL KINDS OF MONEY, ETC.

Classes	In circulation 1 July 1909	In circulation 1 July 1910	Decrease	Increase
Gold coin	$599,337,698	$590,877,993	$8,459,705	....
Standard silver dollars	71,987,900	72,432,514	....	$444,614
Subsidiary silver	132,331,798	135,583,731	....	3,242,933
Gold certificates	815,005,449	802,754,199	12,251,250	....
Silver certificates	477,717,324	478,597,238	....	879,914
Treasury notes, act of 14 July, 1890	4,203,415	3,662,525	540,890	....
United States notes	340,118,267	334,787,870	5,330,497	....
National bank notes	665,538,806	683,659,535	....	18,120,729
Total	$3,106,240,747	$3,102,355,605	$26,582,342	$22,688,190

point, $161,973,703.77. In 1910 they were about $161,000,000.

Customs have been the main source of revenue. The tariff first enacted in 1789 was simply for revenue, but afterward became also a system of protection to home industries. The total receipts from customs since the organization of the government are over $8,800,000,000 and exceed all other taxes. The amount received from sales of land is $304,000,000.

The ordinary expenditures of the States are comparatively small, limited mainly to legislative expenses, salaries of officers, expenses of the militia, educational and charitable purposes, with extraordinary expenditures for buildings and public works. The six largest States in the Union spend about $30,000,000.

Municipal corporations — cities, towns, and villages — have been so extravagant that it has been found necessary in many States to restrict their indebtedness to a percentage (varying under the laws of different States from 3 to 10 per cent) of the taxable property, as determined by the assessors, but excepting from such limitation debts incurred for supplying the inhabitants with water, for manufacturing gas and electricity, and for temporary loans in anticipation of taxes. The tendency of modern times is to increase the exceptions. How far a city or town incorporated for the purpose of providing its citizens with good government should use its revenue in any business for profit-making is a question of the day. Such use makes the citizen and taxpayer, whether so disposed or not, share in the risks, and contribute and pay for any losses, blunders or errors, while he is without redress and claim for damages which the inhabitants would have were the business done under a proper contract with responsible parties.

As there is no uniformity in the accounting systems of different cities, it is difficult to compare their revenues or expenditures. Public interest in their financial reports would be increased were they only based on a uniform system, simple and comprehensive, separating ordinary receipts and payments from the extraordinary, with sufficient detail to show the actual purpose for which the money is expended.

The finances of corporations and individuals have assumed governmental proportions. The recent combination of different companies under one management with a capital of more than a billion of dollars has suggested new ideas of the possibilities of finance when applied to consolidations of business enterprises. The financial transactions between the bankers of the different cities of the world are conducted almost with the facility of local transactions.

The statesman who suggested the protection of a man's property in his inventions through patent laws, must have been one of the most far-sighted of financiers. The great resources of the country are in a large degree the result of inventions made in consequence of those laws. To those inventions are due the agricultural contrivances that have made possible the great harvests of the West; the colossal engines that draw the trains; the mechanical safeguards that facilitate and protect transportation; much of the machinery that enables the mills and manufacturing establishments to compete with the world; the drills that open the mines; the telephone, telegraph, and a vast number of industries throughout the land; all contributing directly and indirectly to the public revenue. And the

COMPARISON OF REVENUE PER CAPITA BY SOURCES.

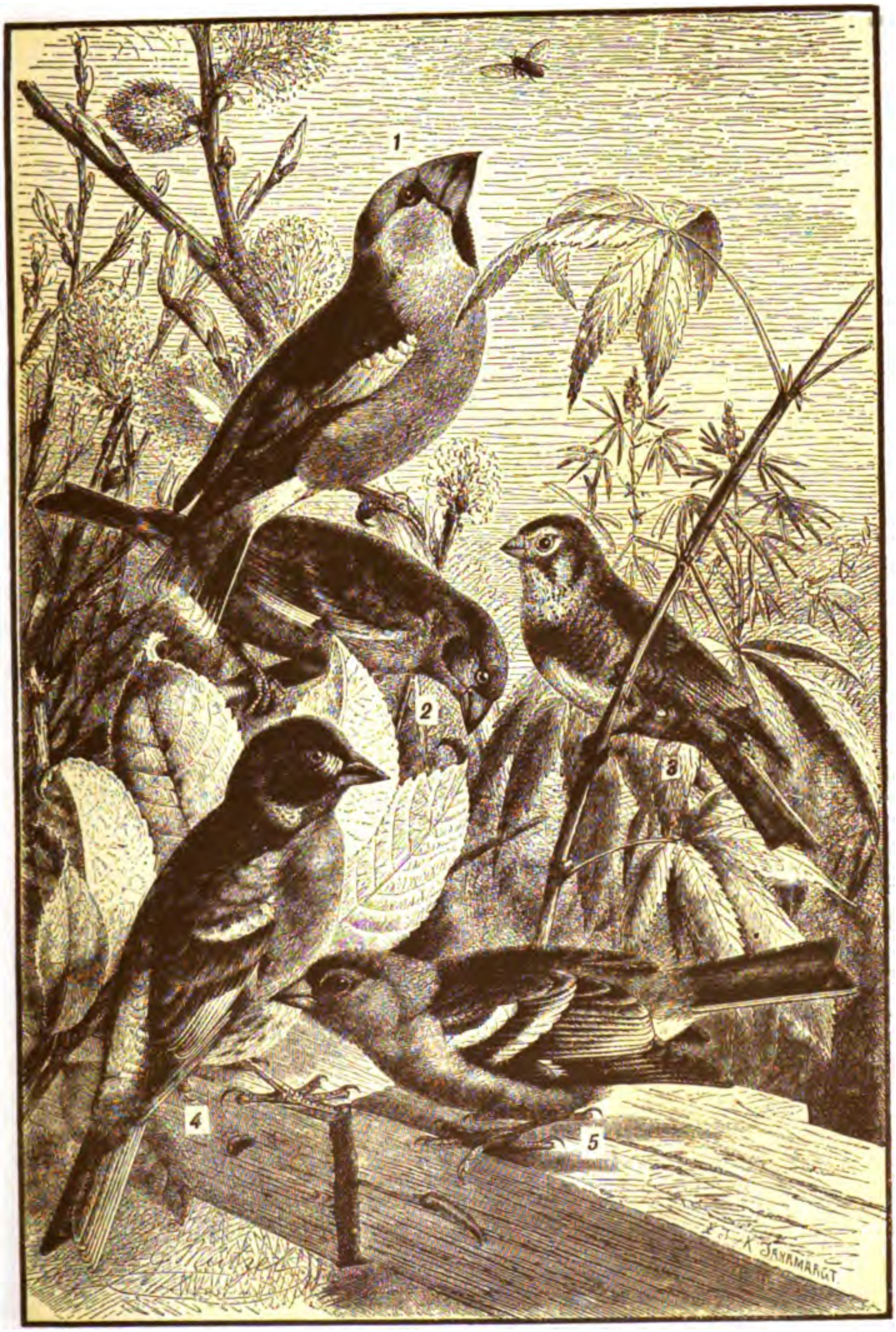
Data from Bulletins of United States Department of Labor, compiled by H. S. Chase.

	Boston	New York	Average Ten cities	Chicago	Philadelphia	St. Louis	Baltimore	Cleveland
Population	561,000	3,437,000	560,500	1,699,000	1,294,000	575,000	509,000	382,000
Wealth per capita, valuation at 100 per cent	$2,012.79	$1,458.27	$1,028.86	$1,177.17	$877.87	$1,014.51	$1,109.70	$784.13
Property tax	$28.72	$21.69	$11.42	$8.41	$14.07	$11.43	$11.38	$9.33
Liquor licenses	2.63	1.65	1.25	1.87	1.33	1.74	78	1.21
Other licenses	09	15	36	32	49	89	11	04
Fines and fees	32	23	25	31	51	49	10	34
Franchises	10	16	29	20	....	27	67	19
Water-works	4.57	2.09	2.00	1.94	2.48	2.79	1.86	2.00
Special assessments	63	99	98	1.91	....	34	10	1.76
Docks and wharves	....	72	02	01	03	11	07	....
Gas-works, electric light plants, ferries and bridges, markets, cemeteries, bath-houses and other	8.31	2.65	1.53	85	1.48	2.07	4.10	1.80
Total revenue (excluding loans)	$45.37	$30.33	$18.10	$15.82	$20.39	$20.13	$19.17	$16.67

COMPARISON OF BORROWED MONEY PER CAPITA IN 1900.

Borrowed money (loans, including temporary tax loans)	$17.08	$25.59	$5.21	$3.02	$5.09	....	$12.34	$9.87

SONG FINCHES.



1. Hawfinch. 2. Greenfinch. 3. Linnet. 4. Chaffinch 5. Mountain Finch

great corporations, even the monopolies, are working in the service of the people, for, in the proportion that they satisfy that service, lies their profit. The creation of banks reduced the rate of interest; that of railways the cost of travel; that of great industrial combinations the price of commodities. The greater their service the greater their profit. They are compelled by the unwritten laws of trade to reduce charges to the point that will bring the largest net returns.

A French writer on Finance has with reason stated that no advantage is to be derived from a comparison of the financial systems of America with those of France, nor even in comparing those of the different European countries with each other.

Each nation seeks its prosperity in accordance with its environment and the habits and requirements it has inherited from the past.

It may be interesting, but not very useful, to an American to know that the octroi duties on articles of food and other commodities, collected at the gates of a French city,— a system that has come down from the Middle Ages — amount to much more than half of the ordinary revenue of the city; and it is not apparent that any benefit can come from comparing the relative percentage of the national to the local expenditures of the different countries, although the figures vary greatly; nor in comparing the pensions of foreign nations, frequently, as in Germany, and France, paid by employment or minor offices, with the pensions of the United States which are always paid by a treasury check.

The income taxes as levied in England are no longer possible in the United States under the Constitution and the decisions of the Supreme Court. They were tolerated during the great Civil War only as a war measure.

The theories of German Socialists, who would make a government one great industrial corporation, are incompatible with the individual liberty and self-reliant character, with the freedom of industry and of labor inherited by American people. See BANKS AND BANKING; BANKS, SAVINGS; COINAGE; MONEY; TAXATION; TRUST COMPANIES; TREASURY, UNITED STATES.

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FRANKLIN HAVEN,
Late Pres. Merchants' National Bank, Boston.

Finance, United States Superintendent of. See FINANCE.

Finback, a whalebone whale of the genus *Balænoptera,* having the dorsal fin, which in most whales is small or altogether wanting, well-developed. This genus is widely distributed and contains a number of species, which include the largest cetaceans known. The special finback or «finner» of the eastern coast of the United States (*B. musculus*) is from 30 to 70 feet in length. Other species are described elsewhere, as Sibbald's whale, sulphur-bottom, etc. Despite their huge size, finbacks yield so little oil, and such inferior quality of whalebone that they are little sought for.

Finch, Francis Miles, American poet and jurist: b. Ithaca, N. Y., 9 June 1827; d. there, 31 July 1907. He was graduated at Yale; and wrote the well-known lyrics: ‹Nathan Hale› and ‹The Blue and the Gray,› and a popular college song beginning: ‹Floating away like the fountain's spray.›

Finch, one of the small, seed-eating birds, typical of the family *Fringillidæ* (q.v.). The term as now commonly used refers to the smaller, more ornately dressed genera and species, and especially to those generally kept as cage-birds, as the canary, chaffinch, goldfinch, hawfinch, greenfinch (qq.v.), and similar well-known kinds of the Old World. In the United States the name is reserved for the American goldfinch and its greenish relative of the north, the pine-finch; for the purple finch (q.v.), the rosy finches (q.v.) of the genus *Leucosticte;* the house-finch (q.v.) of California; and especially for the small gaudily colored southern birds of the genus *Cyanospiza,* represented in the Northern States by the indigo-bird (q.v.). In these little seed-eaters, such as the nonpareil (*C. ciris*), the lazuli finch (*C. amœna*), and the Mexican varied (*C. versicolor*), the plumage of the male abounds in the richest tints of changeable blue and green, varied by other colors in pleasing contrast. All utter sweet and varied notes, and are prized not only as garden visitors but as cage-birds. The name is also commonly given in the northeastern United States to the «grass-finch,» more properly a sparrow (*Poocætes gramineus*), a brown bird which breeds and spends its life in open fields, singing most sweetly at dusk, and easily recognized by the fact that when it takes flight it exhibits a white feather on each side of the tail.

Finch-falcon, one of a genus (*Microhierax*) of tiny falcons, or «falconets,» of the East Indies. One, *Microhierax cœrulescens,* is found in the Himalayas and Burmese countries. Not one of these little hawks is seven inches in length; they are said to be used by native chiefs for hawking insects and button quails, being thrown from the hand like a ball. They sit solitary on high trees, and, according to native accounts, feed on small birds and insects.

Finck, Henry Theophilus, American musical critic: b. Bethel, Mo., 22 Sept. 1854. He was graduated at Harvard in 1876; and from 1878 to 1881 studied physiological psychology at Berlin, Heidelberg, and Vienna. He is musical critic of the New York Evening *Post.* His works include: ‹Wagner and His Works›; ‹Romantic Love and Personal Beauty› (1887); ‹The Pacific Coast Scenic Tour› (1890); ‹Chopin, and Other Musical Essays›; ‹Lotos Time in Japan› (1895); ‹Spain and Morocco›; ‹Paderewski›; ‹Primitive Love› (1899); ‹Songs and Song Writers› (1900), etc.

Finder, (1) In astronomy, a small telescope fixed to the tube of a larger one, the axes of the two instruments being parallel. The finder has a larger field of view than the principal instrument, and its purpose is to find an object toward which it is desired to direct the larger telescope. (2) As a military term: The finder invented by Lieut. Fiske, of the United States navy, is now being constantly used experimentally and may be called complete. It consists of a telescope mounted high enough to sweep the sea. In front of it is the high stone wall of the fort. Or the finder is placed along shore behind rocks or trees to screen it from the enemy's observation. When the enemy's ship comes within sight the telescope is slowly turned until aimed full at the ship. At the same time the hand moves along, pressing a button, after a certain mechanical method, by which the telescope and the button correspond. As soon as they come within the same focus an electric button, connected with a submarine mine lying in the harbor, is pressed, which blows up the ship.

Finding of Goods. See Lost Property.

Find'lay, Ohio, city, county-seat of Hancock County, Ohio; on the Toledo & O. C., the Lake E. & W., the Ft. W. & W. and other railroads; 44 miles south of Toledo. It is in the heart of the oil and gas fields of Ohio. It contains Findlay College, electric lights, electric railroads, several banks, and numerous daily, weekly, and monthly periodicals. Findlay is widely known on account of its phenomenal yield of natural gas. In November 1888 the Tippecanoe gas well was drilled and yielded 31,000,000 cubic feet of gas per day. In the vicinity are rich beds of clay and large deposits of gravel and sand. There are manufactories of glass, pressed bricks, furniture, wooden implements, nails, and an oil refinery, machine shops, foundries, extensive potteries, and rolling-mills. Pop. (1910) 14,858.

Findlay College, a coeducational institution in Findlay, Ohio; founded in 1882 under the auspices of the Church of God; reported at the close of 1910: Professors and instructors, 17; students, 300; volumes in the library, 1,300.

Fine (probably from Latin *finis*), in English law, formerly signified "an income or a sum of money paid at the entrance of a tenant into his land; a sum paid for the renewal of a lease; and an assurance by matter of record founded on a supposed previously existing right. In every fine which was the compromise of a fictitious suit, and resembled the *transactio* of the Romans, there was a suit supposed, in which the person who was to recover the thing was called the plaintiff, conusee, or recognizee, and the person who parted with the thing the deforceant, conusor, or recognizor. Besides the specific uses above referred to, fine has the signification in general law, in America as well as in Europe, of a pecuniary penalty exacted either in punishment of, or in compensation for, an offense, whether committed against an individual, in contravention of the laws of the community, or against the community itself. Fines in this sense are of very ancient origin, and have been sanctioned by the practice of all nations, ancient and modern, from the lowest to the highest degree of civilization. In the earlier stages of society fines form, for an obvious reason, one of the principal modes of punishment. Prisons and artificial restraints impose a burden on society which it is not yet able to bear, and demand an organization which it has not reached. There remain only fines, corporal chastisements, and death. The last is suited only for the gravest offenses; the second is rendered impracticable in the case of many offenses by the dignity of the offenders; the first in many others by their impecuniosity.

In the most civilized nations of antiquity, Greece and Rome, fines were numerous and frequently excessive. In the early period fines were imposed in cattle, the highest amount of the mulcta or damnum being 2 oxen and 30 sheep. The ancient Germans, being a people who highly valued freedom, admitted hardly any punishment but fines, and their influence extended the use of this penalty among other European nations. A murder was commuted by a payment to the family of the deceased. In the ancient French law fines were divided into two classes, according as they were fixed by law or left to the discretion. This distinction has been abolished since the Revolution by the fixing of maximum and minimum limits for all fines. In England the common law recognizes fines, but does not determine their amount, and this is usually fixed in particular statutes, with a discretion to the judge. The rule in England from an early period, and which was incorporated in Magna Charta, was that no man should be amerced beyond his circumstances and personal estate, leaving to the land owner his land, to the merchant his stock, and to the husbandman his wainage or team and instruments of husbandry.

Fine Arts is the generic term for those arts intended primarily to affect the emotions, such as sculpture, painting, music, etc., as distinguished from the *useful arts* which serve the physical needs of life. Art in general may be defined as the exercise of the creative faculty through some form of material activity controlled and inspired by the intellect. All industries are therefore included under the category of the arts in precisely the degree in which they involve the creative activity of the intellect. The products of the useful arts are designed for purposes external to themselves, to serve the needs of daily life; in other words, they are made to be used. The products of the fine arts, on the other hand, are created for their own sake; they are an end in themselves, or — to be more accurate — they exist for the sake of the emotions they are designed to express and to arouse. A chair, however superbly carved, is a work of useful art, because made primarily to be sat on; but a picture is painted for its own sake, not to be used but to be looked at and to excite pleasurable emotions by its beauty of subject, of drawing, of color; it is a work of fine art. So also a poem or a symphony is produced for the sake of the æsthetic emotions it arouses, not for that of any practical or material use to which it is to be put; it is a work of fine art. The fine arts, then, are those whose appeal is to the æsthetic emotions; and just to the extent in which any work of art does so appeal does it enter within the domain of the fine arts. Painting, sculpture, music and poetry belong obviously in this domain; pottery, weaving, building, metal-working are as obviously useful arts. Architecture stands on the borderland of both domains, being the noblest of the useful arts, and yet, in all those elements in which the architect seeks after pure beauty as distinguished from mere utility or fitness, entering into the field of the fine arts, and summoning painting and sculpture to serve it as sister arts.

Besides these major fine arts, there are certain minor arts which minister to the lower forms of æsthetic pleasure. Dancing belongs in this category, when practised not as a social diversion, but as an artistic sequence of beautiful and rhythmic movements, as in the ancient Greek choral dances, the modern Samoan dances, and the higher forms of the operatic ballet. Fireworks are also a form of fine art, having no other purpose than to delight the æsthetic sense by beautiful combinations of luminous form and color. Landscape gardening is a higher branch of the fine arts, in which we may also include as a subdivision all decorative and artistic water-works such as fountains and artificial cascades.

The industrial arts, again, are divisible into two classes; those in which utility or the consideration of the function of the product predominates, and which are called distinctively the *useful* arts, such as pottery, ironwork or carpentry; and those in which the idea of beauty predominates, and which are called the *decorative* arts, such as carving, embroidery, inlay and mosaic, painting (other than that of easel pictures), stained-glass work and the like. The decorative arts closely approach the fine arts, and there is indeed a wide borderland which is common to both, in which the fine arts, especially painting and sculpture, are employed for the embellishment of structures or of movable objects, losing thus somewhat of their independent *raison d'être*. Into this borderland enter such decorative arts as mosaic, glass-staining and carving, in which the product possesses high artistic value independently of the object or structure to which it is applied. Whether, therefore, a given work belongs among the fine arts or the decorative arts is really a question of how far it has been created for its own sake, and how far its artistic value and merit can be dissociated from the object or structure which it embellishes. Thus the sculptures of the Parthenon pediments, although ostensibly created as decorations for a temple, are really of such surpassing merit as works of sculpture, quite apart from their architectural setting, that they are universally recognized as masterpieces of pure sculpture. On the other hand, the charming figures of nymphs of the Seine carved in low relief by Jean Goujon, in the Fountain of the Innocents of Paris, are so evidently designed for the special places they occupy in that structure and lose so much of their value and significance when detached from it, that they are universally recognized as masterpieces of decorative art.

In the appeal which works of fine art make to the emotions there is nearly always a large element more or less purely intellectual, which must be distinguished from the purely æsthetic quality of the work. Thus a picture represents a scene or an episode; a poem tells a story or extols a religious or moral conception; a statue presents the effigy of a hero, or the embodiment in allegorical form of some abstract conception; a song expresses an idea of love, patriotism or war; a building excites admiration by its bold construction and logical planning. Each of these works addresses itself in these particulars rather to the mind than directly to the feelings. In judging them, therefore, as works of art, we must eliminate the element of purely intellectual satisfaction from our judgment in order to weigh correctly the purely æsthetic excellence of the work. A picture æsthetically beautiful may be uninteresting from the intellectual point of view; still more often does it happen that a picture appeals powerfully to the reason, and even reaches the emotions through the intellect, and is nevertheless totally lacking in æsthetic excellence. Thus a political cartoon or a clever caricature may produce a powerful emotional impression upon the public mind, although execrable as a drawing and destitute of artistic excellence. Its effect is produced by a primary appeal to the intelligence, and the emotions which are aroused as the final but secondary result are the moral and intellectual emotions rather than the æsthetic. The appeal of a work of fine art to the æsthetic emotions — to those emotions which are stirred by beauty, by harmony, rhythm, balance, form and proportion — is a direct appeal. It is often difficult to separate the two classes of emotions and to distinguish between the direct æsthetic effect of a work of art and its indirect appeal to the emotions through the intellect, but the distinction is important in any close analysis or detailed criticism, and the failure to recognize it is the root of many erroneous judgments and criticisms by writers on art. This error is frequent in Ruskin's writings, for instance, where moral and intellectual appreciations often dominate what are advanced as purely æsthetic judgments. (See CRITICISM.)

It does not, however, by any means follow that those are the highest forms of art which appeal most exclusively to the æsthetic sense. Instrumental music, dancing and pyrotechny are the branches of art most completely free from intellectual and non-artistic elements, but they can hardly be classed as the "highest" forms of art. On the contrary, intellectual satisfaction is a natural accompaniment of the pleasure we experience in a work of art; and, other things being equal, the higher the form and grade of the work, the higher will be the intellectual satisfaction experienced. The artist who can at once touch our deepest emotions and appeal to our highest intelligence while he delights our æsthetic sensibilities, has reached a higher plane of art than one whose work makes no such intellectual impression. And while it is true that any philosophical analysis of a work of art and of the impressions it produces must make the distinctions above set forth, it is also true that in the enjoyment of those impressions the spectator seldom or never makes such distinction and is in no wise called upon to do so. The philosophical analysis of art is one thing, the subjective enjoyment of it is another. The total impression it makes is very complex, and not easy to divide into its constituent elements. In general, the highest art is that which makes the deepest impression by reaching and touching the highest as well as the deepest phases of our emotional being, alike through the senses and the intellect; not that whose appeal is most purely and exclusively æsthetic, nor that whose execution and technic are the most finished and perfect.

Principles and Technic.— The underlying principles of all the fine arts are the same; the *application and development* of these principles vary with the art, its medium of expression, the purpose of the work, the personality of the artist, the time and place in which he lives and many other circumstances. The application and development of the underlying principles in a given form of art constitute its *technic;* the shape and direction imposed upon this technic by external conditions of time and place, and the resulting characteristics or habits and manner of design, constitute its *style*. It is of course impossible to lay down in a brief *exposé* like the present article, the laws which are recognized as common to all the arts. We can only observe that they relate to ***composition,*** which deals with the general plan of the work and the relations of its various parts in that plan or scheme, determining the sequence, balance, proportion and rhythm both of the whole and of its parts; and to ***expression*** or the manner in which the underlying sentiment, conception or idea of the work is developed and made clear and effective. Thus in every perfect work of art, whether of music, poetry, drama, painting, sculpture or architecture, there should be a fundamental ***theme,*** a dominant idea or conception which runs through the whole, giving coherence and significance to all its parts. The æsthetic conception is to be distinguished from the ***subject*** of the work. Thus (for instance) in Millet's 'Angelus' the subject of the painting is two peasants ceasing work for a few moments to pray in the field at the sound of the Angelus. The artistic conception embodied in the treatment of this subject is that of distance, of the soft glow of early evening, of quietude and rest; the picture expresses the dreaminess of gathering twilight by the use of the simplest of themes — two peasant figures outlined against the sky and field — using for this purpose the subject indicated by its title. In giving form to the underlying conception the artist must secure predominant ***unity*** of character or spirit, ***harmony*** in the assemblage and relation of all the parts, and such ***variety*** in details as to avoid the danger of wearisome monotony and secure that pleasurable æsthetic emotion which comes from changes not too rapid or violent. This variety may, and generally should, introduce the element of ***contrast,*** but discreetly, so as not to destroy the harmony and general unity of the whole. ***Proportion*** should be just, giving to each part and to the whole suitable relative amounts and dimensions; and the whole work should possess both ***rhythm*** and ***balance.*** Balance is equilibrium between features or groups of features, an equilibrium of size, of intensity of color or tone, of importance or of accent; rhythm is the ordered succession of variations of accent or emphasis.

Expression depends, as has already been said, upon many elements — the sentiment or conception to be expressed, the medium of expression, the technical resources of the art, and the personality of the artist being the chief. Music is peculiarly expressive of moods, of emotions apart from definite mental concepts; poetry of lofty moral and spiritual ideas; painting of the beauty of nature as interpreted through the artist's personality; architecture of sublimity, splendor, grace and elegance revealed in the triumph of mind over matter; sculpture of feeling revealed in the form and attitude of living beings. Each art has its own range and capacity for expressing feelings, emotions and definite ideas which it carries over from the mind of the interpreting artist to that of the spectator or listener, so that expression is always measured by impression. In general, if the inquiry be limited to the strictly æsthetic field, what is expressed is not a categorical idea capable of statement as a proposition, but rather an abstract emotion, sentiment, or quality, as of grandeur, elegance, power, sublimity, grace, pathos, or the like. In works of representative art, such as painting and sculpture, fidelity to nature enters largely into this power of expression. This is a different thing from the photographic mimicry of nature which is sometimes admired by undisciplined minds, and which often characterizes the periods of decline in the history of art. This close mimicry is an affair of skilful technic, not of high art. To paint a key hanging on a nail so that the spectator shall mistake it for a real key is clever painting, but little more. A great painting is one which seizes most completely and conveys through the eyes to the soul most effectively the essential truth, the deep underlying aspects of a scene, subordinating to this end whatever details would interfere with the force and completeness of this impression. These aspects and this impression must first exist in and possess the artist's mind: he can put into his work only what he himself possesses; he must be himself inspired if his work is to be inspiring, for a truly great work cannot be produced by accident, nor by an inferior artist. Great works of art may be marked by flawless technical execution, but this perfection of technic is not essential to their greatness. It is, indeed, oftener found in decadent art than in the periods of greatest inspiration; for it is when inspiration flags that technical finish begins to be exalted into the place of first importance.

Style.— It would at first seem as though the works of the artist, who has in all ages sought to clothe his conceptions in the forms that seem to him most suitable and expressive, would in every case be stamped with so personal and individual a character that classification by styles, periods and epochs would be impossible. But as a matter of fact, however various the moods, emotions and conceptions of artists of different races and ages, and however manifold the forms in which they are expressed, the men of any one land or period are in general so conditioned by like circumstances and environment, by similarity of customs, traditions and education, by widely-prevailing ideals and aspirations and even by popular taste and fashion, that they are unconsciously constrained into certain similarities of subject and of manner by which the art of their time and place is clearly distinguishable from that of any other. The social, religious, political and intellectual forces of the age inevitably mould the products of its art, and the resulting predominant manner, form of expression, quality and habit of design we call the *style* of that age and place. The most daringly original artist cannot wholly escape the influence of his environment and education, and those who succeed most completely in disregarding these influences are so few in number that they rarely affect the general set of the art-currents of their day, though they may sometimes prove to be the heralds of new ideas and methods — that is, of a new style — which comes into recognizable existence at a later date. Styles are therefore not mere fashions, nor can they be created or abolished. They are growths, the natural characteristic interpretation of the spirit of the age. The fine arts are therefore rightly studied as the true exponents of the civilizations which produced them. Greek art differs from Roman art as Greek civilization differed from that of Rome. Gothic art differs from that of the Renaissance, French from American art, the art of the end of the 19th century from that of its beginning. The phenomena of style are true of all the arts — of literature and poetry as unmistakably as of music and sculpture, of painting and architecture. It is, however, in the last named art that styles are most clearly distinguished, not only because of the definiteness and permanence of its forms, but also and chiefly because architecture touches the daily life and habits of a people at more points than any other art, and deals with materials and technical processes which of necessity vary widely in different lands and ages. (See ARCHITECTURE.)

History.— A history of the fine arts is really a history of the rise, growth, decay and succession of styles in the various arts, with special mention of those masterpieces which embody in the highest degree the qualities and characteristics of those styles, or which mark the various stages of their development. It is manifestly impossible within the limits of this article even to sketch in outline the historic developments of the several fine arts; for this, the reader is referred to the histories of art mentioned in the bibliography at the close of this article, and to the briefer notices in this encyclopædia under the several titles: ARCHITECTURE; DANCE; DRAMA; MUSIC; PAINTING; POETRY; SCULPTURE. All that can be here attempted is a brief review of the general movement of the fine arts from the earliest beginnings to the present time. Music and poetry, as the subjects of separate treatment in detailed articles will be omitted or only incidentally alluded to in this brief sketch.

Primitive and Savage Art.— The fine arts, properly speaking, have no existence in primitive society. The artistic instinct of man is in the earlier stages of civilization confined to efforts to imitate natural forms, especially human and animal, to which he attributes supernatural powers and which he worships; and to the decoration of his weapons and implements of daily life. Primitive art is therefore primarily symbolic or fetishistic (see ANTHROPOLOGY; FETISH), or else industrial. But in this early art, and particularly in that which has a religious or symbolic character, lie enfolded the germs of a higher development, out of which in a higher stage of civilization come the true fine arts, in which the artist seeks to realize ideals, and the beautiful, sought after for its own sake, begins to take the place of the grotesque and terrible. Very little remains to us of the products of truly primitive mankind, but these few relics, consisting chiefly of chipped flint tools and weapons and engraved or carved ivory and bones, coming down to us from the Stone Age (both palæolithic and neolithic) are of great value as evidence of the observation of nature and of the decorative instinct of the men of preglacial times. The art of modern savage and barbarous tribes is generally treated as exemplifying various stages of the evolution of art from the most primitive beginnings, but it has not yet been demonstrated beyond question that modern savages really offer us a picture of truly primitive conditions. There is much in the life and customs of many savage peoples that is quite as suggestive of degeneracy as of primitive simplicity, and it is next to impossible to find a tribe that has not in some way — direct or indirect — felt the contact of other peoples and been thereby lifted or degraded measurably from its own original status.

Early Oriental Art.— The most ancient works of developed fine art known to us are those of the two great historic cradles of civilization, the valleys of the Nile and of the Tigris-Euphrates. The works which preceded the developed art of those valleys, previous to 4000 or 5000 B.C., are not yet sufficiently known to reveal clearly the stages by which this art grew up from its primitive beginnings, or to prove whether it was indigenous or sprung from roots to be sought in other soil. We know that in each of these valleys a wonderful civilization existed thousands of years before the Christian era, producing works of art of a high order in poetry, in painting and sculpture, and in architecture. That of Egypt was on the whole more advanced than the Chaldæan, especially in sculpture and architecture — for which arts, indeed, it enjoyed the advantage of abundant granite and limestone, syenite and basalt, while the art of the Chaldæans was restricted by the scarcity of stone and even of good timber in the broad, flat basin of the Tigris and Euphrates. Clay and its derivatives — brick, tile and terra-cotta — were the chief resource of the Chaldæan artist, and his libraries of clay-tablets and cylinders, his stupendous palaces of sun-dried brick lined with stucco and enameled tiles, and the skilful use he made of his scanty limestone and alabaster for sculptural decorations and pictures in low relief, show how strong was the artistic instinct of that people. In their pictorial art, displayed in the low-relief of their alabaster slabs, they showed greater fidelity to nature and greater freedom from conventional traditions, than the Egyptians. The foregoing remarks apply equally to the early Chaldæan monarchy and to the great Assyrian empire which finally, about 1200 B.C., overthrew and absorbed it. The art of Egypt was, however, incomparably richer. Its resources were vastly greater, and the pyramids (see PYRAMIDS) and tombs — the chief remaining monuments of the earlier dynasties from the first to the 12th (about 5000–2100 B.C.), the magnificent temples of the later dynasties, and the great relief-pictures and colossal portrait-statues with which they were adorned, are highly impressive examples of fully developed arts. Grandeur, impressive dignity of scale and monumental simplicity of line and mass characterize the temple architecture of the Egyptians and their monumental sculpture; they achieved also remarkable results in portrait sculpture, and the pictures painted in their tombs and carved or engraved as well as painted on their temple walls and columns, give graphic representations of Egyptian life and religious conceptions. The Egyptians also excelled in the decorative and industrial arts, using color in ornament and in pictorial decoration with skill and good taste. Religious conceptions dominated all this art, and symbolism, verging on primitive fetish-magic, pervaded all its manifestations, while its forms of expression were so controlled by hieratic traditions that it never emerged from conventionalism as did Greek art later. Architecture was the one independent art to which the other arts were subservient. In Chaldæo-Assyrian art the religious idea is less exclusively predominant, war and personal luxury dividing with religion the control of the arts. The art of these two great centres — Egypt and Chaldæa — jointly influenced all the early art of the Mediterranean basin; of Crete and later of Rhodes and Cyprus, of the early Greek culture in Mycenæ and Tiryns, of Phœnicia and later of the Persian empire which overthrew both Egypt and Assyria. But in none of these centres was a great art ever developed except in Greece and Persia. In the other centres the decorative and industrial arts are more important than the fine arts; in Persia there was developed in the 6th century an impressive palatial architecture accompanied by remarkable work in decorative relief sculpture, but the style was short-lived and exerted no lasting influence on art in general, passing away with the decline of the Achæmenian dynasty.

Greek Art.—The Aryan Greeks, who migrated from Central Asia in successive waves to Greece, the Ægean islands, southern Italy and Sicily, and the sea-coast provinces of Asia Minor, developed a culture essentially different from that of Egypt or Assyria, less exclusively dominated by religious conceptions than the one, far less inspired by the pursuit after splendor than the other, but animated from the start by the instinctive reaching out after ideals of pure beauty of form. Sculpture early displayed the effort to imitate the perfection of nature, unhampered by conventional restrictions, and in its highest development in the 5th century B.C. gave to the world, in countless statues and reliefs of gods and goddesses, heroes and athletes, superb models of an idealized perfection of human beauty which have never been surpassed and seldom equaled. Greek architecture, serving the gods and the state alike, developed a few simple varieties of the column and entablature (see ARCHITECTURE), into a style of the utmost elegance of proportion and refinement of detail, which continued in use for over five centuries. In this style (for all Greek architecture may be considered as constituting a single style) three forms of columns each with its special entablature, were successively evolved, the Doric, the Ionic and the Corinthian, the first being the most severe, the last the most ornate in character. (See ARCHITECTURE, PARTHENON.) Greek poetry, drama, oratory and prose literature, inspired by a new spirit of inquiry, by the highly-developed civic patriotism of the Greeks, and by their love for perfect rhythm and proportion, reached a nobility of style which has made them the study and in large measure the model of all succeeding ages. We know little of Greek music or of Greek painting, but the highly-developed decorative art of the Greeks, as revealed in their vases, their coins, and whatever else has come down to us of the appurtenances of their daily life, displays everywhere the same pursuit of ideal beauty, the same love of harmony, proportion, balance and rhythm, which we observe in their literature, sculpture and architecture, and which found another medium of expression in their sacred dances.

Greek art in its origins drew freely from Egyptian, Assyrian and Mediterranean art, especially in its decorative motives, but early began to transform the motives and ideas it borrowed, so that it became the most original and creative art of all antiquity, reacting upon later Egyptian art and contributing to Roman art its most vital elements. The age of Pericles, succeeding the Persian wars, was the age of its highest development; during the 4th century (sometimes called the Alexandrian Age), it declined in purity and sought after splendor, sinking thereafter gradually into insignificance. But it came to new life in its inspiration of Roman art, and in some of its provincial manifestations in Syria and the Byzantine empire, after the time of Constantine. See GREEK ART.

Roman Art.—While Greece was declining, Rome was rising to the political-military mastery of the world. The Roman civilization was practical and material rather than artistic and philosophical like the Greek. The Romans were soldiers, organizers and engineers, not artists and theorists. But with the conquest of the Greek states in the 3d and 2d centuries B.C. the Romans began to acquire a taste for the splendors and refinements of Greek art. Greek philosophy and literature were cultivated; Greek statues and bronzes adorned the villas of the wealthy and the fora and public buildings of the capital; Greek artists were employed to copy the great works of Greek sculpture, to carve and decorate and even to design and erect temples and palaces for the Romans. This new Græco-Roman art was, however, entirely unlike the Greek art whose forms it adapted to new purposes. It was inferior to the Greek in every department but one — that of architecture, and in this it differed so radically in principle from the Greek that comparison is hardly possible. The Roman skill in engineering construction and the Roman love for grandeur, for vastness of scale and splendor and for sumptuous beauty of materials, constrained architecture into new paths, resulting in the creation of new and varied types of buildings, in which details borrowed from the Greek columnar style, and often executed by Greek artists, were adapted to new uses in conjunction with the arch and vault which the Greeks had never employed. The spaciousness and imposing splendor of the Roman temples — as exemplified, for instance, in the still extant and superb temple known as the Pantheon (q.v.), built about 124 A.D. — and of their baths, amphitheatres and basilicas, were such as had never before been realized in any land or age. The decorative arts of carving and mosaic, of stucco-relief ornament and marble incrustation, as applied to architecture — we might almost say the whole art of architectural decoration as distinguished from pictorial painting and sculpture applied to buildings — were first developed systematically by the Romans. To the three Greek "orders" of architecture — the Doric, Ionic and Corinthian — which they adopted and modified, they added two others: the Tuscan, a survival of the rather primitive Etruscan form of column, and the Composite, a variant of the Corinthian. Roman sculpture was inferior, attaining little distinction except in some of the imperial portrait-statues and busts. Painting was more highly developed and, although practised chiefly as a decorative art and by Greek artists, as shown by the ruins of Pompeii (q.v.) and Herculaneum, produced in various parts of the empire works of portraiture and of ideal representation of a high order. (See PAINTING.)

Early Christian and Byzantine Art.— The age of Constantine (330 A.D.) witnessed a great transformation, not only in the political organization, but also in the religion and art of the civilized world. Christianity, triumphing over three centuries of proscription and persecution, was recognized as the religion of the empire, and Roman art, which had shared in the decline of the imperial power, found a new field in the service of this religion. In all the symbolism of Early Christian Art we trace the survival of pagan Roman symbols invested now with new meanings, and the architectural types of the Roman basilicas and tombs were modified for the building of Christian churches and baptisteries. Sculpture suffered for centuries from the proscription which resulted from its association, in the mind of the early Church, with pagan deities and idol-worship; but painting took on new life in the service of the Church, especially in the derivative form of mosaic (see Mosaic) and in the illumination of ecclesiastical manuscripts. The field of the arts was a narrow one, and none of them rose to very high or independent development except in the Byzantine empire. Here, especially in Constantinople (which, after the fall of Rome before the Goths in 476 became, and for a considerable time remained, the most enlightened, prosperous and conspicuous city in Christendom) (see Constantinople), the arts flourished; architecture developed new forms and applications of the vault and especially of the dome (see Dome), and produced in the great church of the Divine Wisdom (ἡ Ἁγία Σοφία, commonly called Santa Sophia) at Constantinople (532–38) a stupendous masterpiece, never surpassed in its way. Byzantine architects, mosaic-workers, decorators and manuscript-illuminators were in demand throughout the Christian world of the 6th to the 11th centuries; the superb church of St. Mark at Venice (about 1070 A.D.) is one monument of their employment in foreign lands, and Ravenna is full of Byzantine art. The highly decorative though conventional ecclesiastical style of painting of the Byzantines, dominated by the types of face, figure and symbolism employed in the mosaics, frescoes and altar-pieces of their churches, was carried not only into Greece, Russia and the Balkan provinces, where it has survived to this day, but also into Italy, Germany and southern France, as we shall see later. In Syria there grew up, concurrently with the earlier Byzantine style a strong local school of architecture which has left impressive ruins, quite distinct in style alike from the Byzantine and Roman.

Moslem Styles.— During the Dark Ages which succeeded the fall of Rome, the lamp of culture burned brightest in Constantinople and in the Moslem states. The Arabs had extended their conquests during the 7th and 8th centuries over Syria and Persia, northern Africa, Spain and Sicily. Destitute themselves, at the outset, of artistic culture, they rapidly absorbed that of the nations they conquered, and the experience of Rome in the conquest of the Greek states was repeated. The new art that grew up was wholly different in spirit and detail from that of any of the conquered peoples, although largely executed by artists from their ranks. It was applied to different uses and expressed a different order of ideas and sentiments. The Moslem hatred of idolatry led to an almost absolute proscription of painting and sculpture and this restriction upon two of the highest forms of artistic expression may in part account for the extraordinary development in their stead, of the decorative arts in Moslem lands. These, without the all-pervading symbolism of ancient Egyptian art, reached a very high power of expression or suggestion of moods and feelings which — if we may believe some students of these arts — raises them almost to the plane of music and places them clearly among the fine arts. Unlike western art, in which *form* has always been paramount, Moslem art, like all Asiatic art, excels in the treatment of *color*. The Persians were the only Moslems to develop the art of painting, and with them it was practised chiefly in the form of miniature pictures and manuscript illustration, in which — as in the semi-naturalistic floral decorations of their tiles and fabrics, they showed considerable observation of nature. In architecture the Moslems have always excelled on the decorative side, and the buildings of the Arabs and Moors seldom display boldness of construction or largeness of scale. In Turkey, however, where Byzantine models were followed, and in Persia and India, where the Aryan element is dominant, the Mohammedan mosques, tombs and gates are often of imposing grandeur of scale and admirable in structural design.

Mediæval Art.— Meanwhile as Europe emerged slowly from the chaos and barbarism of the Dark Ages, with the development of new nationalities, chiefly Celtic and Germanic, a new Christian civilization and new art were taking shape, dominated by the Church of Rome, whose institutions, both monastic and hierarchic, were established throughout all Europe except the Byzantine empire, where the Greek rite prevailed. The Church absorbed all activities not occupied in the warfare of feudalism, and the arts were practised almost wholly in her service. The centuries from the 5th to the 11th were the Dark Ages when throughout northern, central and western Europe chaos and ignorance were universal; but with the dawn of the 11th century order began to emerge from the chaos, and the wealth and power of the monastic orders began to show themselves in the building of great abbey-churches and monasteries, as well as in the copying of manuscripts and the study and teaching of the narrow scholasticism of the Church. In some places — notably in France — the episcopal authority was hostile to that of the monasteries; but elsewhere the two were in harmony, and between them they developed a very active and prolific architecture of abbeys, cathedrals, churches, monasteries and hospitals, at first crude, powerful, massive (see Romanesque Art); later developing its structural system experimentally along logical lines, towards greater loftiness, lightness, elegance, refinement of detail and splendor of decoration, the ribbed vault, pointed arch and flying buttress being the characteristic features of this system; stone window-tracery, stained-glass windows, lofty spires and pinnacles, and a marvelous wealth of symbolic and grotesque and floral carving, the leading elements in the decorative dress of this architecture. The earlier massive style is called the *Romanesque;* the later, completely developed style the *Gothic* (about 1160–1500). As sculpture had been the mistress art of Greece, so was architecture that of the Middle Ages; painting and sculpture wrought chiefly in her service. Yet the sculpture of the Middle Ages, although chiefly executed for the decoration of churches is — especially in France — so important for its own sake, so intrinsically noble and beautiful, as to claim with justice an independent rank. Painting, however, remained a subordinate art, formally decorative and adhering in great measure to Byzantine traditions (see above). For decorative work, for mural painting, which only in the 14th century, in Italy, began to cast off the fetters of this tradition (see Cimabue; Giotto; Painting). And for stained glass in large windows, this formal and conventional style served well; but it stood in the way of any independent progress in painting. Architecture first, and sculpture in the second place, were the great arts of the Middle Ages; but poetry and the drama were also practised. War and chivalry were the chief inspiration of poetry, although a few truly noble hymns were born of the religious consciousness of the Middle Ages: the drama existed chiefly in the form of «miracle-plays,» «mysteries,» and «moralities,» of minor importance as literature, although interesting as the germ of the great dramatic art of the Renaissance.

Renaissance Art.— The conspicuous characteristics of the mediæval Christian world may be summed up in a few words as follows: War and religion were the controlling forces, the feudal system and the Church the institutions through which these worked; obedience to authority the universal rule of life. Under these conditions the individual was submerged in the mass, and only under the pressure of external authority. But this condition could not last forever. The love of personal liberty, the longing for self-expression, though long repressed, were not extinct and began to assert themselves with increasing earnestness and effectiveness, in proportion as civilization advanced, and external authority ceased to be the only synonym of protection and safety for the individual. Independence first began to develop by the introduction of the idea of voluntary obedience to an authority constituted by those subject to it, in the place of involuntary and compulsory subjection to powers claiming authority directly from God or from some other mysterious and external source. This new conception appeared in the industrial and artistic guilds of many mediæval cities; in many «free towns» which claimed certain immunities and privileges as direct inheritances from Roman times and exercised and regulated these through elective governing bodies chosen by the burghers; and in the free republics of Italy, like Florence and Venice. Through the 14th century this idea was germinating, especially in Italy, where it received a powerful stimulus from the revival of the study of the classics, which kindled admiration for the freedom of classic culture and for the beauty of classic art and literature, and aroused a new spirit of secular study, research, and inquiry. This led to the Humanist movement, which was on the one hand a movement for individual culture, and on the other a movement of protest against the narrowness and asceticism of ecclesiastical authority. Not only the dictates but the very foundations of authority began to be questioned. Men began to reach out into new fields of thought, to explore nature and antiquity alike, and the beginnings of modern science are to be traced back to this new spirit of independent investigation. This revival of classic learning, this intellectual awakening, is known as the Renaissance — the new birth of free thought and individual culture. The fine arts soon felt its influence. In painting, the study of nature, the pursuit of ideal instead of conventional types, broke the long dominion of the Byzantine ecclesiastical traditions. The Florentine and Siennese schools inaugurated the triumphant course of Italian painting, which led from Cimabue and the great innovator Giotto finally to the superb masterpieces of Raphael, DaVinci, Michelangelo, Titian, Veronese, and Tintoretto. In this triumphal progress of the art of painting it rose from a subordinate ecclesiastical decorative art to the leading position among the arts, the invention or discovery of the process of painting in oils (see PAINTING; VAN EYCK) being a potent contributory factor in this progress. Sculpture had already in the works of Niccolò Pisano (q.v.) felt the inspiration of the study of classic models, but its development was less important than that of either painting or architecture. It remained long subordinate to the latter, although within this relatively limited field many of its products, especially in Italy and France, were of a very high order and some of them unsurpassed. It did not, however, attain complete independence until Michelangelo (q.v.) in the 16th century, made it the medium of expression of his mighty conceptions, rivaling in power and grandeur, if not also in beauty, the noblest masterpieces of Greek art.

Architecture underwent a complete revolution. The Gothic style had never been in Italy anything but a foreign importation, an imitation of French and German details with no assimilation of the structural ideas on which the Gothic style was based. With the new passion for classic study, architecture was on its decorative side made a medium for the expression of this taste by the adoption and imitation of the decorative details of classic Roman ruins. The secularizing tendency of the age and the rapidly growing love of personal luxury, led to the building of palaces, villas and stately gardens, and to the erection of tombs of pompous and imposing magnificence, while churches were built with barrel-vaults and domes in place of the ribbed vaults of Gothic design, and were adorned with the columns, pilasters, and entablatures of the Roman orders, with Roman scrolls, arabesques and arcades. The lofty dome, crowned with a lantern and borne on a high drum encircled with columns and pilasters, became a feature of the later churches, and St. Peter's (q.v.) at Rome, the largest of all churches, embodies in the most magnificent fashion this new type (1503-1629). In all the arts of the Renaissance it is the artist as an individual that claims our attention; although we class the works of the Renaissance by schools and periods — because even individuals feel the constraint of their environment — the personal element is always conspicuous in a manner unknown in mediæval art, in which relatively few names of artists have come down to us.

Poetry and literature felt with the other arts the transforming influence of the classic revival, not only as to form but also as to subject-matter. The drama outgrew the naïve puerilities of the miracle-plays and took on the dignity of an independent fine art, reaching its highest development in the Elizabethan and particularly the Shakespearian drama at the close of the 16th century.

The movement of the Renaissance spread from Italy to the north and west, but found — so far as art was concerned — in France, Germany, Great Britain, and the Low Countries the Gothic style so highly developed and so firmly intrenched that the transformation of taste and of style was very gradual in these countries. In France the Renaissance in art was inaugurated by Italian artists imported by Charles VIII., Louis XII., and Francis I. after their several campaigns in Italy between 1483 and 1525, and manifested itself first in the châteaux and in the tombs of royal and princely or noble families, but the style was very far from resembling the Italian. It was not till the reign of Louis XIV. (1645–1715) that architecture, sculpture, and painting took on the Italian Palladian (see PALLADIO) or classic character in any marked degree. There was constant strife between the distinctively French and classic elements. In Germany and England the Italian manner was even later in asserting itself; throughout the 16th and much of the 17th century the persistence of local, national, and mediæval conceptions and forms resulted in great variety and picturesqueness in architecture, the final disappearance of which in the 18th century was hardly compensated for by the more stately but less original formally classic style that replaced it. Sculpture hardly flourished outside of France, but painting developed in Germany and the Netherlands three important schools in the 16th and 17th centuries — the German, the Flemish, and the Dutch, whose most celebrated representatives were respectively — among many others almost equally famed — Hans Holbein the Younger, Rubens, and Rembrandt. A strong Spanish school also grew up, and in England in the 18th century portraiture and landscape-painting reached a high level. But meanwhile architecture was declining in power and originality; sham and pretense, pomp and affectation were taking possession of society, and taste was corrupted at the fountain-head. The first third of the 19th century — indeed the first half — was a period of artistic poverty and destitution, in all the arts and throughout the civilized world. From this deplorable condition the arts have risen under the impulsion of new forces, social, intellectual and economic, due to the extraordinary changes and the marvelous progress of the last 50 years.

Bibliography.—The bibliography of the fine arts is enormous; only a few of the most familiar and available works can be here specified. The reader is advised to consult Ile's 'Bibliography of the Fine Arts.' Among general hand-books: Lübke, 'History of Art' (in German or in English); 'College Text-books on the History of Art,' edited by Prof. J. C. Van Dyke ('Architecture' by Hamlin; 'Painting' by Van Dyke; 'Sculpture' by Marquand and Frothingham); Kugler, 'Hand-book on Architecture' (German or English); Statham, 'Architecture for General Readers'; 'Modern Architecture'; Fergusson, 'History of Architecture in all Countries'; 'Indian and Eastern Architecture'; 'Modern Architecture'; Fletcher, 'A History of Architecture'; Mitchell, 'Ancient Sculpture'; other books on ancient sculpture by Murray and by Perry; Gardner, 'Greek Sculpture'; Perkins, 'Italian Sculptors'; 'Tuscan Sculptors'; Marshall, Eidlitz, Raymond, Ruskin, Viollet-le-Duc, on æsthetics and art criticism, works by Hegel. On painting works almost innumerable: there exists no one general history of painting of important dimensions (note Van Dyke as above), but numerous books on special schools and epochs: *cf.* Champlin, 'Cyclopædia of Painters and Painting.'

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Finfoot, one of the extraordinary tropical birds of the family *Heliornithidæ*, now considered near allies of the rails, so called on account of the broad scalloped webs along each toe. The best known one is *Heliornis fulica* of northeastern South America, which is about 13 inches long, and mainly brown, with a white throat, red bill, and feet banded with yellow and black. Other larger species belong to Africa and the Malayan Peninsula. These birds, which frequent the swamps or rocky streams of inland woods, fly heavily, and push themselves out of the water with their feet. They swim and dive well, and run swiftly on land.

Fingal, fing-gal, a once popular epic by James Macpherson, which appeared in 1762. The poet being a favorite, 'Fingal' had an immense sale. The subject of the epic is the invasion of Ireland by Swaran, king of Lochlin, Denmark, during the reign of Cormac II., and its deliverance by the aid of the father of Ossian, King Fingal of Morven, on the northwest coast of Scotland. The poem opens with the overthrow of Cathullin, general of the Irish forces, and concludes with the return of Swaran to his own land. See OSSIAN; MACPHERSON, JAMES.

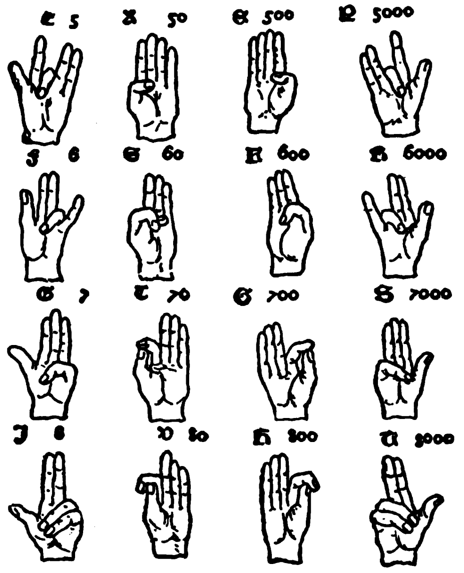
Fingal's Cave, a curious cavern formed of basaltic columns, in the Isle of Staffa, one of the Hebrides, on the west coast of Scotland, 25 miles from Oban. See STAFFA.

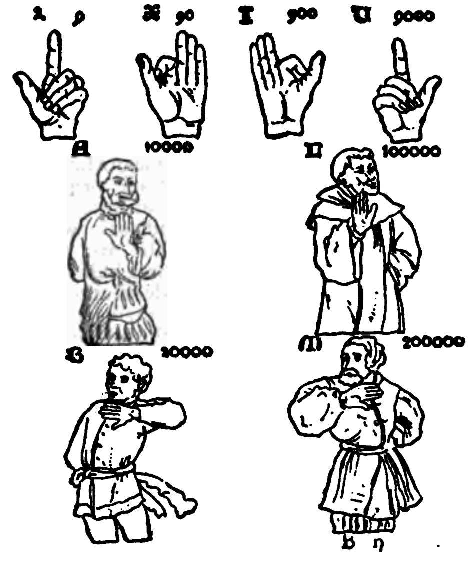
Finger. See HAND.

Finger-grass, a crab grass (*Panicum sanguinale*, Linn.), a well-known annual, common in nearly all parts of the United States, growing in cultivated fields and about dwellings. It is a weed in gardens and among hoed crops. In grain fields after harvest it frequently springs up in such quantity, particularly in the Southern States, as to yield one or even two good cuttings of hay. This spontaneous growth affords excellent pasturage, as well as hay of first quality if properly cured. The stems are much branched, and in good soil attain a length of 3 to 4 feet. This grass contains little fibre, and dries quickly when cut, but if after cutting it is wet by rains or heavy dews its value for hay is almost wholly destroyed.

Finger Notation, a method of representing numbers by the position of the fingers or hands, analogous to the digital language of deaf mutes. The system is an ancient one and has had three distinct ramifications: (1) The obsolete one of mere numerical representation, to retain the numbers erased during operations on the sand abacus, and probably on the other forms as well (see ABACUS); (2) the one leading to a kind of international language, helpful in bargaining at the great fairs of antiquity and the Middle Ages, and still used in the East; (3) that of actual computation, the so-called finger reckoning, still somewhat used in certain parts of the world. Of these three the first was the most important, and with the second it resulted in a number language quite as international as the Hindu-Arabic numerals (see NUMERALS) which led to its decay. The antiquity of the system in Egypt, Greece, and Rome is attested by several classical writers, Juvenal, for example, speaking of the aged Nestor as numbering his years upon his right hand, that being the one used for numerals exceeding 99. Herodotus, Pliny, Macrobius, Plautus, Seneca, Suetonius, and probably Aristophanes and Solomon (Proverbs iii. 16) are among the other witnesses to its use among the common people in ancient times. In the early centuries of the Christian era it was well known, for it is mentioned by Tertullian (c. 200 A.D.), St. Ambrose (c. 375 A.D.), and St. Augustine (c. 400 A.D.). To the Venerable Bede, however, we are indebted for our most definite knowledge of the mediæval system in the West, and to his treatise, 'De loquela per gestum digitorum,' in his 'Opera omnia,' (Paris 1862, tomus I., p. 689), the student should refer for the best description extant. The same notation, not so fully explained, appears in a work written about 800 A.D., although assigned to Cyril of Alexandria ('Liber de computo S. Cyrilli Alexandrini,' published by L. A. Muratori in his 'Anecdota,' Napoli 1776), and in one by Radulph of Laon, c. 1100 A.D. (consult 'Abhandlungen zur Geschichte der Mathematik,' Bd. V., p. 91). The international character of the system is further evident from two poems, one in Arabic (Marre, 'Manière de compter des anciens avec les doigts des mains, d' après un petit poëme inédit arabe de Chems-Eddin el Mossouli,' in the Boncompagni 'Bulletino,' t. I., p. 309), and the other in Hebrew, by Samuel ibn Abbas (Steinschneider, 'Die Mathematik bei den Juden,' in the 'Bibliotheca Mathematica,' Ser. II., Vol. X., p. 81), and from a description by Nicholas Rhabdas of Smyrna. In his 'Epistles on Arithmetic,' written about 1341, Rhabdas gives the digital notation as it had probably been used in Asia Minor for many centuries, and, aside from Bede's description, this is our best source of information. For a brief digest, consult Gow, 'History of Greek Mathematics' (Cambridge 1884, p. 24). For the Greek text, with French translation by Tannery, consult 'Notices et extraits des manuscrits de la Bibliothèque nationale,' t. 32, p. 147 (Paris 1886). The system had not yet died out in Europe when printing was invented, and Paciuolo (q.v.) sets it forth in a page of illustrations in the first great modern treatise on mathematics ('Sūma de Arithmetica Geometria Proportioni & Proportionalita' . . . vinegia . . . . M.cccc.lxliiij, fol. 36, v.). Several arithmeticians of the 16th century gave descriptions of the method, including Recorde (q.v.), the author of the first arithmetic printed in English. The accompanying illustration is from the most elaborate treatise on the subject, that of Aventinus ('Abacvs at qve vetvssissima, vetervm latinorum per digitos manusq numerandi (quin etaim loquendi) cosuetudo, Ex beda cu picturis et imaginabus . . . Ratispone . . . 1532), a work enough esteemed to warrant an edition as late as 1710.

The most common form of finger reckoning was that involving multiplication, the factors being between 5 and 10, thus rendering the table beyond 5 × 10 superfluous. This form is very old, and is not yet obsolete. For example, to multiply 9 by 8, think: 5 and 4 are 9 (raising 4 fingers on one hand); 5 and 3 are 8 (raising 3 on the other hand); 4 + 3 (raised fingers) = 7 tens; 1 × 2 (bent fingers) = 2 units; 70 + 2 = 72.





In addition to the sources above cited, consult: Stoy, 'Zur Geschichte des Rechenunterrichtes,' dissertation (Jena 1876); Treutlein, in the 'Abhandlungen zur Geschichte der Mathematik,' Bd. I., p. 21; Bombelli, 'L' antica numerazione Italica' (Roma 1876, p. 102); Günther, 'Geschichte des mathematischen Unterrichts im deutschen Mittelalter' (Berlin 1887, p. 12), and 'Untersuchungen zur Geschichte der mathematischen Wissenschaften' (Leipzig 1876).

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Finisterre, Cape. See Cape Finisterre.

Fink, Louis Maria, American Roman Catholic prelate: b. Triftersberg, Bavaria, 1834. He came to the United States in 1852, was ordained priest 1857, and was successively stationed at Bellefonte, Pa.; Newark, N. J.; Covington, Ky.; and Chicago. Later he became prior of the Benedictine monastery, Leavenworth, Kansas, and vicar-general of that State. He was appointed Bishop of Leavenworth 1871.

Finland, Grand Duchy of (called by the natives, Suomen-maa, «land of marshes»), a country of northern Europe, including, with the exception of part of Lapland, the extreme northwestern portion of the Russian empire; bounded on the north by Russian Lapland; east by the provinces of Archangel and Olonetz; south by Lake Ladoga, the province of St. Petersburg, and the Gulf of Finland; and west by Sweden and the Gulf of Bothnia; length, 600 miles; average breadth, about 240 miles; area, 144,255 square miles.

Topography.— Finland, which is divided into 8 provinces, consists principally of a tableland from 400 to 600 feet above the level of the sea, and interspersed with hills of no great elevation. In the north, however, the Manselka Mountains have an average height of between 3,000 and 4,000 feet. The coasts, particularly on the south, are surrounded by a vast number of rocky islets, separated from the mainland and from each other by intricate and narrow channels, rendering the shores of the country easy of defense in case of hostile attack by sea. The chief natural feature of Finland is its many lakes, which extend like a network over a large proportion of its surface; some of them being of very considerable size. The greater number of these are in the south and east; several of them have intercommunication and generally abound with islands. There are numerous rivers, but none of much importance.

Climate.— The climate is rigorous. Even in the south the winter lasts from six to seven months, and in the north from eight to nine months. Dense fogs are very frequent; heavy rains take place in autumn, and in May and June the thaws put a stop to nearly all traveling. In the north the sun is absent during December and January; but during the short summer, while the sun is almost constantly above the horizon, the heat is often very great; and near Uleaborg, in about latitude 65°, the corn is sown and reaped within six or seven weeks. Crops in all parts of the duchy are exposed to the double danger of being destroyed by sudden frosts, and by the ravages of a variety of caterpillar called turila by the natives.

Various.— The principal geological formations are granite, which very easily disintegrates, hard limestone, and slate. The soil for the most part is stony and poor. Iron, copper, marble, and sulphur are the chief minerals. Rye, oats, and barley are grown. The most important products are timber, potash, pitch, tar, and resin, which are extensively exported. Next to agriculture, stock breeding and fishing form the leading occupations of the inhabitants. The chief imports are salt, grain, and articles of clothing. Finland's imports amount to $69,000,000 and its exports to $48,000,000, giving a total foreign commerce of $117,000,000.

History.— The Finns were pagans and most aggressive. They frequently attacked the neighboring countries, but especially Sweden. They continued to live under their own independent kings till the 12th century, about the middle of which the country was conquered by Saint Eric, the king of Sweden. When he subdued Finland, sent to them Saint Henry, the bishop of Upsal, to preach Christianity to the people. The province of Wiborg was conquered and annexed to Russia by Peter the Great in 1721; the remainder of the country became part of the Russian dominions (also by conquest) in 1809. Ever since that period the Russian government has endeavored, by conciliating the Finnish party, and promoting objects of national importance, to attach the bulk of the population to its interests; but in this it is said not to have been eminently successful. Abo (the ancient capital), Wasa, and Wiborg are the places where law courts are held. In 1640 a university was established at Abo, but it was removed later to the present capital, Helsingfors. The majority of the people are Lutherans, but many belong to the Greek Church. The emperor of Russia nominates the 18 members who constitute the highest administrative body possessing authority over Finland. The states, composed of the representatives of four social orders, that is, nobles, clergy, burgesses, and peasants, are convoked by the emperor; and no new laws can be enacted, nor new taxes imposed, without their sanction. These four orders form the Diet, which meets every few years for the transaction of business. The governor-general of Finland, who represents the emperor, is president of the senate, usually a Russian, and is appointed by the emperor. The ordinary procedure of the courts of law is in accordance with the forms in existence under Swedish rule.

Language and Literature— The language of the Finns (Finnish or Chudic) belongs to the northern division of the Ural-Altaic family of languages, and is most nearly allied to the languages of the Esths, Lapps, Mordvins, Voguls, and Hungarians. It possesses all the German vowels, *a, e, i, o, u, ä, ö, ü,* which again give 8 double vowels and 12 diphthongs. Like the other Altaic languages it adheres to the «law of harmonic sequence of vowels,» according to which the vowels are divided into two classes, heavy (*a, o, u*) and light (*e, i,* etc.), and only vowels of the same class can occur in the same word. The language is remarkably rich in declensional forms, there being as many as 15 different cases expressing such relations as are expressed in English by *near, to, by, on, in, with, without, along,* etc. By this means these cases are made to express the relations of space, time, cause, etc. There is no distinction of gender in Finnish nouns. The possessive pronoun is indicated by suffixes. The verb resembles the noun in its capability of taking on different shades of meaning by corresponding modifications, and is in this respect a remarkable philological phenomenon. The Finnish proper is divided into three principal dialects, the Karelian or eastern; the Savo in central Finland; and the Tavastian in the west. This latter was used in the original translation of the Bible, and thus became the parent of the literary Finnish.

Finnish literature is valuable chiefly for its rich stores of national poetry, which has been collected only in modern times. Longfellow's 'Hiawatha' is, in style, an imitation of the Finnish epic. The old and popular poetry of the Finns, as it appears in the various *runor* or ballads, is governed by rules of «quantity» as in that of the Greeks and Romans, not by accent; rhyme occurs only rarely; alliteration is employed as a rule. These poems, which had been preserved by oral tradition, were collected by Lönnrot, and in 1835 he published them, under the title of ‹Kalevala,› with a second enlarged edition in 1849. He also published in 1840 ‹Kanteletar,› a collection of 592 ancient lyric poems and 50 old ballads; the ‹Suomen kansan sanalaskuja› (1842), a treasury of 7,077 popular proverbs; and ‹Suomen kansan arwoituksia› (1844), a collection of 2,188 riddles. Another work that deserves notice is Eero Salmelainen's collection of legends and stories in prose, ‹Suomen kansan satuja ja tarinoita› (4 vols. 1854–62). The first book in the Finnish language was printed at Abo in 1544, its author being Michael Agricola, afterward bishop of Abo, who also translated the New Testament and part of the Old into Finnish. A complete Finnish Bible appeared in 1642. Lönnrot's Finnish-Swedish dictionary has been published by the Finnish Literary Society, and Dr. Donner has a dictionary of the Finno-Ugric languages in German. Finnish is becoming more and more the vehicle for imparting instruction. There are many establishments for the higher education of both sexes in which the Finnish tongue is used, and about half of the 800 students at Helsingfors University speak Finnish. Works on science and history, as well as poetry, have been written in Finnish in recent times, and there are now a considerable number of Finnish newspapers. Pop. 2,483,249. Pop. of Helsingfors, the capital, 77,500.

Consult: Topelius, ‹Finland Fræmstalldt i Teckning›; Gerschau, ‹Versuch einer Gesch. Finland›; Brown, ‹Finland in Archaic Times› (1893); Finnish authors, ‹Finland in the Nineteenth Century›; Clive-Bayley, ‹Vignettes from Finland› (1895); Tweedle, ‹Through Finland in Carts› (1903).

Finland, Gulf of, an arm of the Baltic Sea, on the east side, having Finland on the north, and the Russian governments of Esthonia and Saint Petersburg on the south. The length of the gulf from east to west is about 250 or 260 miles; breadth at the entrance or narrowest part, 40 miles; toward the head, where it is widest, about 80 miles. It receives but few rivers, and none of them, with the exception of the Neva, which enters it at its upper extremity, of any great size. It contains numerous islands, of which Kronstadt (q.v.) is the largest. There are various cities and towns of considerable importance along its shores, Saint Petersburg on its eastern extremity.

Fin'lay, Charles John, American physician: b. Puerto Principe, Cuba, 3 Dec. 1833. He studied at the Rouen Lycée, France, and was graduated from the Jefferson Medical College, Philadelphia, in 1855. In 1881 he was delegate from Cuba to the international sanitary conference at Washington, and in 1903 to the sanitary congress also held there. In 1902 he was made chief sanitary officer of Cuba. Finlay was the first to set forth the theory of the transmission of diseases by the agency of mosquitoes, which he advocated in connection with the yellow fever as early as 1881.

Finlay, George, English historian: b. Faversham, Kent, 21 Dec. 1799; d. Athens, Greece, 26 Jan. 1875. Fired with enthusiasm on behalf of Greece he went to that country to help it in shaking off the Turkish yoke, and spent some time at Missolonghi in close intimacy with Lord Byron. He purchased land in Attica, and henceforth lived chiefly in Greece. His great work on Greek history came out at intervals between 1844 and 1861, and shortly after his death it was published as thoroughly revised and greatly improved by himself, entitled ‹A History of Greece from its Conquest by the Romans to the Present Time, 146 B.C. to 1864 A.D.›. It has been described as the greatest historical work in English since Gibbon's ‹Decline and Fall.›

Finley, John Huston, American educator: b. Grand Ridge, Ill., 19 Oct. 1863. He was graduated at Knox College, taking a post graduate course at Johns Hopkins University. He served as secretary of the State Charities Aid Association of New York 1889–92, founding and editing the ‹State Charities Record› and ‹The Charities Review.› He was president of Knox College 1892–9, editor of ‹Harper's Weekly› for 1899, and editor of ‹McClure's Magazine› 1900. He was appointed professor of politics at Princeton 1900, and became president of the College of the City of New York in 1903. He collaborated with R. T. Ely (q.v.) in writing ‹Taxation in American States and Cities.›

Finley, John Park, American meteorologist: b. Ann Arbor, Mich., 11 April 1854. He was educated at the State Normal School and State Agricultural School. In his position as chief of the Signal Service Bureau of the Pacific Coast he has given much attention to the phenomena of meteorology, and has written extensively upon the subject. His works include: ‹Tornadoes› (1887); ‹Manual of Instruction in Optical Telegraphy› (1889).

Finley, Martha (pseudonym of MARTHA FARQUHARSON), American writer for girls: b. Chillicothe, Ohio, 26 April 1828; d. Elkton, Ind., 30 Jan. 1909. She published: ‹Elsie Dinsmore› (1868); ‹Wanted — A Pedigree› (1872); ‹The Thorn in the Nest› (1886); Twiddledetwit› (1898); etc.; the ‹Elsie Books,› over 25 in number; and ‹The Mildred Books.›

Finley, Samuel, American Presbyterian clergyman: b. Armagh, Ireland, 1715; d. Philadelphia 17 July 1766. Arriving in America in 1734, he was licensed to preach in 1740. The first part of his ministry was much occupied with itinerant labors in promoting the revival of religion, at that time so remarkable throughout the country. His zeal at one time brought him into unpleasant circumstances; for preaching in New Haven, Conn., contrary to a law of the colony forbidding itinerants to enter parishes of settled ministers without their consent, he was seized by the civil authority and carried as a vagrant beyond its limits. In 1744 he was settled at Nottingham, Md., where he remained for seven years, and where, in addition to his ministerial duties, he carried on an academy which acquired a high reputation. In 1761 he became president of the College of New Jersey, now Princeton University.

Fin'ney, Charles Grandison, American Congregational minister: b. Warren, Conn., 29 Aug. 1792; d. Oberlin, Ohio, 16 Aug. 1875. He went to Oneida County, N. Y., in early life and was ordained minister 1824, becoming professor of theology at Oberlin College in 1835 and its president in 1852. He was one of the most famous of American revivalist preachers. Among his works are: ‹Lectures on Revivals› (1835; new edition 1868); ‹Lectures to Professing Christians› (1836); ‹Sermons on Important Subjects› (1839); ‹Lectures on Systematic Theology› (1847); ‹Autobiography,› and ‹Sermons on Gospel Themes› (1876).

Finns, in their own language called *Suomalainen,* and by the Russians *Chudes,* are in the narrower sense a race of people inhabiting the northwest of European Russia (governments of Archangel and Olonetz), but especially the Grand-duchy of Finland. In a wider sense Finnic is the name applied to one of the five chief branches of the northern or Ural-Altaic family of peoples and languages. These peoples were formerly spread over the whole north of Asia and north of Europe, and they are divided into the five families, the Tungusic, Turkic, Mongolic, Samoiedic, and Uralo-Finnic or Finnic family proper. The last or most westerly family still forms the population of north Europe and northwest Asia, and formerly covered the greater part of Scandinavia. It is again divided into four groups or branches (1) the Ugric, to which the Ostiaks, Voguls, and Magyars belong; (2) the Bulgaric or Volgaic, consisting of the Tcheremisses and the Mordvins; (3) the Permic, composed of the Permians, Sirianes, and Votiaks; and (4) the Chudic or Baltic group. To the last belong, besides the Finns proper, the Esths of Esthonia and the Lives or Livonians, the Chudes (in the narrower sense), that is, Karelians, Vepses, and Votes, in the governments of Novgorod and Olonetz, and the Lapps in Archangel and the northern parts of Finland, Sweden, and Norway. The Finns proper are divided into two branches: the Tavastians in the southwest, and the Karelians in the east of Finland. The Finns may properly be identified with the Scythians, and their earliest seats appear to have been the Ural Mountains and the neighborhood of the Caspian Sea. They originally led a peaceful nomadic life, but subsequently practised agriculture and adopted settled habits. They seem to have been compelled to migrate more to the northwest about the beginning of the Christian era, by the pressure of the Gothic tribes, and the country west of the Ural Mountains, more particularly the region where the Great and Little Volga unite, became their second home. From this the bulk of them had again to remove to their present abodes, though considerable numbers were left on the Volga, Oka, Kama, about the sources of the Dwina, in the Ural, and others again spread eastward, some of them as far as the Altai Mountains. The Finns are a serious people, and their so-called amusements show this trait. They are educated, and have most decided opinions as to «Woman's rights»; coeducation is the rule. Although Finland has been united with Russia, or a part of Russia, since 1809, yet the better educated Finns speak the Swedish language. The emperor encourages the use of the Finnish language. The Finns are communicative on business matters and often do not hesitate to tell what other people might call «family secrets.» They ask freely about the affairs of others. They have choirs and musical societies in Finland, and where found in other countries they show a love for music, although their music lacks all suggestion of joyousness. See FINLAND.

Finot'ti, Joseph Maria, American Roman Catholic clergyman and author: b. Ferrara, Italy, 1817; d. Denver, Col., 1879. He studied theology in the Jesuit College, Rome, and in 1845 removed to the United States. In 1852 he left the Jesuit Society and became literary editor of the Boston ‹Pilot.› His works include: ‹A Month of Mary› (1853); ‹Italy in the 15th Century,› ‹The French Zouave› (1863); ‹American Catholic Bibliography› (unfinished).

Fins (of Fishes). See FISH.

Finsen, Neils R., Danish physician, scientist and discoverer of the method of curing lupus or tuberculosis of the skin, and other skin diseases, with light rays: b. Iceland in 1860; d. Copenhagen, Denmark, 24 Sept. 1904. Prof. Finsen's great discovery, that sunlight and electric light rays contain properties that can be used to cure skin diseases and blemishes, was the outgrowth of his experiments begun as a student in the Copenhagen University. In a small attic room of the old surgical academy building the investigation started. A fellow student, Sophus Bang, shared Finsen's enthusiasm for a complete reform in therapeutics. When ill-health came to both young students, Bang sought refuge from his disease in Switzerland, and since has become one of the foremost anatomists of Europe. Finsen remained at home to carry on his investigation in the foggy and cold climate of Copenhagen.

In 1890 Prof. Finsen was graduated from the Copenhagen University, receiving his doctor's degree. Three years later he published in a medical journal an article on ‹The Influence of Light on the Skin,› which aroused general attention because of his assertion that cases of smallpox could be cured by putting red curtains at the windows of the sick-room. This was the beginning of the final triumph. Smallpox became epidemic in 1894 in Copenhagen and the new method was put to the test. The red-room treatment became popular with both the medical profession and the public, for by it not only was the disease cured, but the red rays prevented suppuration and left the patient unmarked by the dreaded scars.

The red-light treatment was but one application of Prof. Finsen's theory that light rays contained healing, and at the best it was but a negative result; it cured only when the disease had run its course. To develop the positive element of the light-ray cure, Prof. Finsen began experimenting with artificial light rays. Soon he found it possible to concentrate rays of the ordinary electric light in such a way as to cure a lupus patient who for eight years had tried every known method. The cure attracted great attention, and both moral and financial support came to the young investigator and discoverer. In 1896 the municipal hospital of Copenhagen gave room on its ground for several small buildings, in which Prof. Finsen's experiments continued on an increasing scale. Then the Danish government came to the support of the institution and it was enlarged and removed to Rosenvaenget, a pleasant suburb of Copenhagen. Many cures of cases previously deemed hopeless were made through the new and enlarged apparatus, the high-power Finsen lamp, which was used under the direction of a staff of physicians of national renown, expert electricians, and specially trained nurses, headed by Prof. Finsen.

Prof. Finsen claimed his invention was prior to that of Prof. Roentgen by about a year. To Finsen is due also the discovery that certain rays of the sun's spectrum are bacteria-destroying, while others are of a healing and curative nature. In December 1903 Prof. Finsen received the Nobel medical prize from the Norwegian parliament. Institutions for the use of the rays are now established in every civilized country.

Few scientists have been recognized as has Prof. Finsen. In April 1904, when King Edward and Queen Alexandra were in Copenhagen, they personally called on Prof. Finsen, and at his bedside expressed their sorrow at his illness. They also congratulated him on his wonderful success.

At his funeral two kings were present, King Christian of Denmark and King George of Greece, and almost every European ruler was personally represented, while princes and high ministers of state and leading scientists paid a last tribute to the dead man.

Wreaths carried by special representatives came from Emperor William, King Edward, Queen Alexandra, and Count Von Bulow, the German imperial chancellor, and the Crown Prince of Denmark; Princes Waldemar, Karl, and Hans were present at the church. See FINSEN LIGHT; PHOTOTHERAPY.

Finsen Light, Finsen ray, blue light, actinic ray, violet and ultra-violet ray, light cure. The Finsen Light takes its name from its discoverer, Prof. Niels R. Finsen. There is a distinction between the "Light Cure" and the Finsen Light Treatment. Sunlight possesses therapeutic properties, and its beneficial effects on animal and vegetable life have been known from time immemorial. But simple exposure to ordinary sunlight will not cure any of the diseases amenable to the Finsen Light Treatment. Prof. Finsen discovered that the actinic rays, those represented in the blue, indigo, violet and ultra-violet sections of the solar spectrum, possess strong bactericidal power, and when concentrated and applied, they will destroy bacteria in five or six minutes.

While the bactericidal features of the violet rays were known experimentally in 1877, lacking the scientific basis, believing the discovery to be a cure-all, "the blue light" was laughed at as quackery. It remained for Prof. Finsen to make a practical application of the facts in treating certain diseases previously supposed to be incurable.

The Finsen Light is a large, specially constructed arc lamp of 40,000 candle power, or forty times stronger than an ordinary arc street lamp, and uses from 60 to 80 amperes of current of 110 voltage. This lamp burns a specially made carbon. In the upper holder is a large carbon, while a smaller one is used in the bottom holder. When properly adjusted for arcing, a maximum number of violet and ultra-violet rays are produced.

The light from this lamp is so intense it is impossible to look at it with the naked eye, and it is necessary for all the attendants and patients to wear smoked glasses while the lamp is in operation. An aluminum hood about two feet wide surrounds the lamp, which hood is fringed on its lower border with a deep crimson-colored paper skirt to further aid in excluding the diffused light from the patient. The concentrated rays are carried from the arc to the patients through four telescopic tubes, known as converging tubes, suspended at an angle of 45°. Each tube contains a series of rock crystal lenses, which are very expensive, but are used because they absorb a greater amount of heat rays, but do not interfere with the passing of chemical rays. These rock crystal lenses are so arranged that reservoirs for running water exist between them. By means of these water screens and the rock crystal lenses, all rays but the violet are eliminated. These rays are converged, concentrated and filtered, thus vastly increasing the healing and bactericidal effects. The heat from the original arc is so intense, that to prevent cracking of the lenses, a stream of cold water is kept constantly circulating through the upper reservoirs or water screens.

To further concentrate and cool the rays a compressor is provided which consists of two rock crystal lenses so arranged in a brass band that a chamber for running water exists between them. This part of the apparatus is used to compress the affected area and make it bloodless during treatment, which facilitates deeper penetration, as the red blood corpuscles have a tendency to obstruct or absorb the actinic rays.

Its advantage over other lamps is due to the greater number of violet or chemical rays produced; its advantage over sunlight is because the atmosphere absorbs a large percentage of the sun's chemical rays. The treatments are given while patients recline on couches, which offer every facility for comfort and quick rearrangement of position. The affected area is placed about 10 inches from the distal end of the converging apparatus, and the treatments, or seances as they are called, take about one hour daily in lupus and rodent ulcer, and in other skin diseases from 10 to 20 minutes, depending upon each individual case. The treatment causes no pain; a red erythematous spot, or blister, appears some hours after the treatment has been given. In a few hours these blisters dry up and a scab forms; in five or six days the scab falls off and the ulcer is healed beneath, leaving the skin free from scar or cicatrix, but red. The redness, however, after a short period fades and leaves the skin white and uncontracted, except where there has been a loss of tissue from the disease before treatment.

The Finsen high power apparatus has maintained its supremacy unrivaled in the treatment of deep-seated affections. None of the cheaper apparatus, such as the London Hospital Lamp, the Dermo Lamp, and the apparatus of Lortet and Genou, Bang, Foveau and Trouvet, Broca-Chatin, or any of the imitation lamps now made in America, have succeeded in producing the therapeutic actinic rays of sufficient strength to cure deep-seated diseases of bactericidal origin, and only in the institutes equipped with Finsen's High Power Apparatus has any positive success been achieved in the treatment of these dread diseases.

The Finsen light treatment has an advantage over the X-ray, in that there is absolutely no danger of burning and consequent sloughing. In the thousands of cases treated by the Finsen light there is not one case recorded that has suffered any ill effects. Such cannot be said of the X-ray treatment, for hundreds have been severely and permanently injured by use of this treatment. The reason for this is, in using the Finsen light treatment we are dealing with a known quantity, while with the X-ray we have an unknown quantity of uncertain action.

On 10 Dec. 1903 the Norwegian Parliament awarded the annual Nobel prize of $40,000 to Professor Finsen, for making the most notable discovery in medical science during the year. To-day, no name in the scientific catalogue is better known than that of Professor Niels R. Finsen, of Copenhagen, Denmark. Since the discoveries of Pasteur, the Roentgen rays are, perhaps, the most wonderful addenda to the history of medicine. But while the latter may be termed the search-lights of the modern surgeon and his class, Professor Finsen stands absolutely alone in the particular field he has selected. Professor Finsen claims that his discovery has priority over the X-ray by about one year. While it has been demonstrated that the Finsen light treatment is a positive cure for lupus (skin consumption), it is now known by recent experiments that it has a much greater range of usefulness than was originally claimed for it. It is now used with decided success in cases of epithelioma (skin cancer), acne vulgaris, acne rosacea, psoriasis, eczema, alopecia-areata (baldness), chronic ulcers, naevus (birth-mark), and tubercular affections involving bone.

If physicians the world over would do nothing more than apply the Finsen light in the removal of birth-mark, such as port wine stains, the discovery would have justified itself by its results. It has been found that the actinic rays can penetrate the human thorax, and this being the case, there is no reason to doubt the conclusion that the Finsen light treatment will later be recognized as a valuable aid in the eradication of the great white plague.

After the cure of Niels Morgenson, of a disease pronounced incurable, Finsen had done what doctors and surgeons would have laughed at as a mad impossibility; he had cured a case of lupus with electric light, using an ordinary hand lens to concentrate the actinic rays. In the fall of 1895, success followed success until the Danish government recognized the value of Finsen's discovery and subsidized the Finsen Medical Institute at Copenhagen. During a period of nine years this institute has grown from a small shed, where they were only able to treat one patient at a time, to a magnificent institute where they are now treating 400 patients daily. Other European nations sent special representatives to Copenhagen to investigate this new «light cure,» and the result was that institutes were established, one in London by the queen of England, another in Saint Petersburg, Russia, by the princess of Russia, and others in Manchester, England; Paris, France, and Chicago, Ill. These various institutes are carrying on a work similar to that of the parent institute at Copenhagen.

The great cost of installing and maintaining Finsen's high power apparatus has prevented many communities from receiving the benefits of this treatment. It is to be hoped that science may yet find a more simple and less expensive method of producing and applying the chemical rays in such quantity and of such therapeutic power that Professor Finsen's discovery may be denied to none. Statistics which have been compiled by the different institutions using the Finson high power apparatus are as follows: At Copenhagen, of 1,367 cases treated up to May 1904, 86 per cent were cured, over 1,000 of which were lupus vulgaris; at the London hospital, 78 per cent of all cases were cured, 10 per cent improved, and 12 per cent disappeared from observation. The Manchester hospital report 92 per cent of cured or improved, 8 per cent disappeared from observation. The Finsen Light Institute of America, located at Chicago, Ill., up to 1 Aug. 1904, reports on 493 cases treated: 82 per cent cured, 9 per cent decidedly improved, 9 per cent failures. In the United States consular reports on file in Washington, D. C., under date of 5 Feb. 1904, will be found the official report of the Hon. R. R. Frazier, United States consul at Copenhagen, regarding the work of the parent Finsen Light Institute.

Prof. Finsen goes so far as to say that in Lupus Vulgaris cures can be obtained in 97 per cent of all cases even where the entire face is involved. In conclusion the author would state, that as a result of the investigations and experiments now being made, we may hope for and reasonably expect that the near future will clear up many a doubtful point and show greater possibilities of the light treatment in the curing of disease. There is no doubt that the Finsen light treatment has taken an exalted position in the field of surgery and advanced therapeutics.

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H. John Stewart, M.D.
Vice-Pres. Finsen Light Institute of America.

Fionni, Matteo, mät-tä'ō fē-ōn'nē, Italian geographer: b. Felizano, Piedmont, August 1827; d. Bologna 1901. He was instructor in the University of Turin 1848-60, then becoming professor of geodesy at the University of Bologna. Among his works are: 'Le Allusione' (1878); 'Le Proiezioni della carte geografiche' with atlas (1878); 'Note ipsometrische sopra la regione bolognese' (1883); 'Mesure offerte delle carte geografiche' (1887); 'Le Projezione cuneiformi' (1889).

Fiord, or **Fjord,** the Norwegian name for a long and comparatively narrow bay or inlet. In North America on the coast of Maine and the coasts of British Columbia and of southern Alaska are bays of this type. Fjords are found on coasts where the land, having been deeply carved either by streams of water or glaciers, is now slowly sinking. In the Norwegian and Alaskan fjords much if not the greater part of the erosion was by ice.

Fir, a name sometimes used as co-extensive with the term pine, and including the whole genus *Pinus.* In a narrower and stricter sense it is the name of a genus of trees (*Abies*) belonging to the order *Coniferæ,* and the sub-order *Abietineæ,* having solitary leaves growing round the branches. The fir is thus distinguished from the pine, the leaves of which grow in twos, threes, fours, or fives; and from the cedar and the larch, both of which have the leaves fasciculated. The term fir, thus limited, is applied only to the different varieties of the silver fir and the spruce fir. The silver firs are distinguished by having the cones erect, scales deciduous, and leaves flat. The common silver fir is the *Abies picea* of botanists, the *Pinus picea* of Linnæus. It is a native of the middle and south of Europe. The finest trees of this species are found in southern Italy; but the largest forests are those on the slopes of the Pyrenees, especially on the French side. It always prefers mountainous regions, and is sometimes found at a height of nearly 6,000 feet. The height of the trunk is sometimes 150 feet, and the diameter above 6 feet. It is the *sapin* of the French, and the *abies* of the ancient Romans. It is from this tree that Strasburg turpentine is procured; and its wood is of great use in ship-building (for masts, yards, and spars), in house-carpentry, etc. To this genus also belong the *A. sibirica,* found on the Altaian Mountains; the Indian silver fir, a native of the slopes of the Himalaya Mountains; and the *A. canadensis* or hemlock spruce fir. Other species of *Abies,* found in western North America (as also in the Himalayas), are trees sometimes rivaling in size the Douglas fir (mentioned below), and likewise yielding excellent timber. Among them are *A. grandis,* a Californian tree of 170 to 200 feet in height; *A. amabilis,* a species much resembling it; *A. nobilis,* a majestic tree, which forms vast forests on the mountains of northern California; *A. bracteata,* a Californian species remarkable for its slender stem, which rises to a height of 120 feet, and yet is only about one foot in diameter at the base, and likewise for the manner in which the middle lobe of each bractea of its cones is produced so as to resemble a leaf. Very similar to the silver fir, but generally of much smaller size, and indeed seldom much above 30 feet high, is the balm of Gilead fir (*A. balsamea*), a native of North America from Virginia to Canada. The wood is of little value, but the tree yields Canada balsam (q.v.).

The spruce firs have the cones pendulous, scales persistent, and leaves tetragonous. Of this division the common or Norway spruce fir (*A. excelsa*) is the most important. It gets the name of the Norway spruce from the fact that in that country it constitutes the principal timber; but it is also extensively cultivated in the middle of Europe, and is found all over Siberia to lat. 70° N. The average height of the tree is from 80 to 150 feet; and it attains its maturity in about 70 or 80 years. The branches, regularly arranged round the main stem and gradually diminishing toward the top, give the tree a pyramidal form. Nearly every part of this tree is of use. The wood (white or Christiania deal) is adapted to various ordinary purposes; the longest and thinnest stems are very valuable in ship-building for making masts; and the stems of those trees that are found at a great height, and in which accordingly the yearly rings are very narrow, are eagerly sought by musical instrument makers for sounding-boards. The bark is used in tanning; the young buds or shoots are used in making the drink known as spruce beer; and the resin which exudes from the tree supplies the common frankincense, and the Burgundy pitch of commerce. The so-called Scotch fir is really a pine (q.v.).

The *Pseudotsuga douglasii,* closely related to the firs, and often regarded as a fir, is named after the Scotch botanist David Douglas, who visited the Pacific coast during the first half of the 19th century, and is known as the Douglas fir or spruce, red fir, yellow fir, Oregon pine (q.v.), etc. It is one of the most important trees of western America, especially of the Pacific States and British Columbia. It is a noble tree, often attaining a height of more than 250 feet, and forms immense forests, especially from lat. 43° to lat. 52°. The bark, when the tree is old, is rugged, and is from six to nine inches thick. The tree abounds in a clear, yellow resin. The timber is heavy, firm, and valuable, and the growth of the tree is very rapid.

Fir′bolgs, or **Fir-Bolgs** (fir-man; bolg′-bag; bag-men), a name given to the descendants of one of the colonies of Nemedians, who fled from Ireland to Greece in about 1900 B.C. Nemedia, or Neimheidh, and his wife Macha, his 4 sons, 34 ships with 30 persons in each ship went from Greece to Ireland because some of the lineage of Nemedia had some years before gone from Greece to Ireland. They found in possession of the country Africans called Fomorians or Fomharaighs, and sometimes pirates. After several conflicts between the Nemedians and Fomorians, the Nemedians were reduced to slavery or flight; they chose the latter. Simon Breac led a colony to Greece, where they were also persecuted and made to serve the people whom they found in the country. One of their tasks was to dig "in the low deep soil," and carry the earth in leathern bags to cover and improve the barren places. From this labor came the name Fir-Bolgs or bag-men. After some years of bondage they again took flight to Ireland, no less in number than 5,000 men and women, under five leaders. See IRELAND.

Firdausī, fēr-dow′-sē, Persian poet: b. Schadab, near Tūs, in Khorassan, about 935; d. there 1020. With the name of Firdausī in the 10th century of our era, modern Persian poetry may be said to begin. Firdausī, however, really forms only one link in the long chain of Iranian literature which extends over more than 25 centuries, and whose beginnings are to be sought in the Avesta, 500 years before the birth of Christ.

The Mohammedan conquest of Iran by the Arabs somewhat resembles, in its effect upon Persian literature, the Norman conquest of England. Hardly two centuries had elapsed before an Iranian renaissance is begun to be felt in Persia. Firdausī comes 300 years after the battle of Nihāvand, in which the eagle of the Persian military standard sank before the crescent of Allah's prophet and the Mohammedan sword; just as Chaucer followed the battle of Hastings by 300 years.

Such was the literary situation at the end of the 9th century. Firdausī was the poet in whom the wave of the national epos culminated in the 10th century. But as there were English poets who struck the note before Chaucer, so in Persia, Firdausī had his literary predecessors. Abbas of Merv (809) was one of these earlier bards. Of greater repute was Rūdagī (died 954) who is said to have composed no less than a million verses. But Firdausī's direct predecessor and inspirer in the epic strain was Daqīqī, cruelly murdered when he had sung but a thousand lines. Yet these thousand verses are immortal, as Firdausī has incorporated them into his poem and has thus happily preserved them. They are the lines that describe the founding of the religion of Zoroaster, priest of fire. There was possibly a certain amount of tact on Firdausī's part in using these, or in claiming to employ Daqīqī's rhymes: he thus escaped having personally to deal with the delicate religious question of the Persian faith in the midst of the fanatical Mohammedans, who are said to have assassinated Daqīqī on account of his too zealous devotion to the old-time creed. With Firdausī, then, the new Persian era is auspiciously inaugurated in the 10th century; its further development through the romantic, philosophic, mystic, didactic, and lyric movements must be sought under the names of Nizāmī, Omar Khayyām, Jalāl-ad-dīn Rūmī, Sa'dī, Hāfiz, and Jāmī.

Firdausī is pre-eminently the heroic poet of Persia. His full name seems to have been Abulqasīm Hasan (Ahmad or Mansur); the appellative «Firdausī» (Paradise), by which he is known to fame, was bestowed upon him, according to some accounts, by his royal patron the Sultan Mahmūd. Firdausī's native place was Tūs in Khorassan. By descent he was heir to that Persian pride and love of country which the Arab conquest could not crush. By birth, therefore, this singer possessed more than ordinary qualifications for chanting in rhythmical measures the annals of ancient Iran. He had undoubtedly likewise made long and careful preparation for his task, equipping himself by research into the Pahlavī or Middle Persian sources, from which he drew material for his chronicle-poem. From statements in the 'Shāh Nāmah' itself, we may infer that Firdausī was nearly 40 years of age when he made the real beginning of his monumental work. We likewise know, from personal references in the poem, that he had been married and had two children. The death of his beloved son is mourned in touching strains. One of the crowning events now in the poet's life was his entrance into the literary circle of the court of Sultan Mahmūd of Ghazna, who ruled 998–1030. To Mahmūd the great epic is finally dedicated and the story of Firdausī's career may best be told in connection with the masterpiece.

The removal of the heroic bard Daqīqī by fate and by the assassin's dagger had left open the way for an ambitious epic poet. Firdausī was destined to be the fortunate aspirant. This poet laureate lived long in the sunshine of the court, and was promised a gold piece for each line he composed. The liberality of Sultan Mahmūd's favor called forth from Firdausī a splendid poetical panegyric, that is only eclipsed by the fierce savageness of the scathing satire which later the poet poured out against his royal patron, when disappointed in old age of the promised reward that was to crown his great work.

Tradition narrates that Firdausī was a septuagenarian when he finished the last line of the 60,000 rhyming couplets that make up the 'Shāh Nāmah.' He now looked for the reward of his life's work. But jealousy and intrigue against him had not been idle during his long residence at court. The grand vizier appears to have induced the sultan to send Firdausī 60,000 silver dirhems, instead of the promised gold. Firdausī is said to have been in the bath when the elephant laden with the money-bags arrived. On discovering the deception, the injured poet rejected the gift with scorn, and dividing the silver into three portions, he presented one of these to the bath steward, the second to the elephant-driver, and he gave the last to the man who brought him a glass of cordial. He then wrote the famous satire upon Mahmūd, and fled from the city for his life. For 10 years the aged singer was an exile, and he would have been a wanderer but for the friendly protection extended to him by a prince of Irāq, who apparently also tried, without effect, to reconcile the sultan and the aged poet. Enjoying the solace of this prince's shelter, Firdausī composed his last work, the 'Yusuf and Zulīkha,' a romantic poem nearly as long as the Iliad, on Joseph and the passionate love of Potiphar's wife for him.

But Firdausī was now advanced to his 80th year, and he seems to have longed to visit his native town of Tūs once more. A sad story is preserved of his death of a broken heart. It is also told that Mahmūd relented and sent to the city of Tūs a magnificent caravan conveying gifts and robes for the aged singer, and bearing likewise the 60,000 gold pieces that had once been promised. But all too late. The treasure-laden camel procession met at the city gate the funeral cortège that was conducting the dead poet's body to the grave. Firdausī's death occurred in 1020. His tomb at Tūs is still a place of pious pilgrimage.

The story of the 'Shāh Nāmah,' — Book of Kings,— may be described in briefest words as the chronicle-history of the empire of Iran, from the moment of its rise in legendary antiquity and during the golden reign of King Jamshīd, through its glorious ascendency under the majesty of the Kayanian rulers, and down to the days of Zoroaster; thence onward to the invasion of Persia by Alexander the Great. The poem from this point follows the various fortunes and changes of the Persian sovereignty, until its downfall and ruin before the Mohammedans and Islam. Firdausī naturally treats his subject as a poetic chronicler, not as a historian;

but there is history in the poem, and he has given a certain unity to his long epic by keeping sight of the aim that he had in view, which was to exalt the fallen glory of Iran. The epic is written in a style befitting the theme. A word must also be bestowed upon Firdausī's romantic poem ‘Yusuf and Zulīkha,’ in which the biblical story of Joseph, as narrated in the Koran, was his source. This poem was in great measure the work of his old age, as it was written after he was 70; but in the episode of Joseph and Potiphar's wife the luxuriousness of color, the richness of imagery, the lavish exuberance, and the passion, might in some degree allow of comparison with Shakespeare's ‘Venus and Adonis,’ or with Marlowe's ‘Hero and Leander.’

Translations of Firdausī should be mentioned. There is an English abridgment of the ‘Shāh Nāmah’ with versions in prose and in rhyme by James Atkinson — ‘Shāh Nāmah’ (1832; cheaply reprinted in the ‘Chandos Series,’ New York 1886). Several versified selections are found in Robinson, ‘Persian Poetry for English Readers’ (privately printed; Glasgow 1883). There is a standard French prose translation of the entire ‘Shāh Nāmah’ by Jules Mohl, ‘Le Livre des Rois’ (7 vols. Paris 1876–8). An Italian prose rendering, also complete, has been made by Italo Pizzi, ‘Firdusi, Il Libro dei Re’ (8 vols. Turin 1886–9); and Pizzi has given extensive metrical renderings in his ‘Storia della Poesia Persiana’ (Turin 1894). In German there is a running paraphrase of the story by Görres, ‘Heldenbuch von Iran’ (2 vols. Berlin 1820). Spirited renderings of selections have also appeared in German; by A. F. von Schack, ‘Heldensagen des Firdusi’ (3 vols. Stuttgart 1877); and by Rückert (unfinished), ‘Firdosi's Königsbuch Schahname’ (ed. Bayer, 3 vols. Berlin 1890–5). Of the ‘Yusuf and Zulīkha’ (complete) there is a German translation into rhymed verse by O. Schlechta-Wssehrd, ‘Jussuf und Suleicha’ (Vienna 1889).

A. V. Williams Jackson.

Fire, the agent of purification; one of the so-called four elements which burns, inflames, warms, or heats; the igneous principle; heat and light emanating visibly, perceptibly, and simultaneously from any body; caloric; the effect of combustion. The terrific energy of fire, the most important agent of civilization, the similarity of its effects with that of the sun, its intimate connection with light, its terrible and yet genial power, and the beauty of its changeful flame, easily account for the reverence in which it was held in ancient times. At a period when cause and effect, form and essence, were not distinctly separated, fire became an object of religious veneration, a distinguished element in mythology, an expressive symbol in poetry, and an important agent in the systems of cosmogony. It gained a place among the elements, and for a long time was believed to be a constituent part in the composition of all bodies. At a later period, fire, under the name of phlogiston, was considered to be the source of all chemical action. See Combustion; Heat.

Fire-alarm, an apparatus, mechanical, electric, and telegraphic, used for detecting fires, and for giving instantaneous notice of an outbreak. See Electric Signaling.

Fire Annihilator, or **Extinguisher,** an apparatus for extinguishing fire. It is charged with water and a mixture of dried ferrocyanide of potassium, sugar, and chlorate of potassa. It is set in action by a blow on a glass bottle containing sulphuric acid, which flows over the charge and liberates gas, which, with the water, is emitted at a nozzle and expended upon a fire to quench it. The earliest of modern fire-extinguishers seems to have been that invented by W. A. Graham, of Virginia, about 1837. It consisted essentially of a contrivance by means of which carbonic acid gas dissolved in water under pressure could be liberated and directed upon burning objects. Many subsequent improvements have made Graham's fire-extinguisher more useful. The Babcock extinguisher consists of a vessel filled with a solution of bicarbonate of soda. In the upper part of the vessel there is a smaller one containing sulphuric acid, suspended by pivots below its centre. When not in use the inner vessel is kept upright by a rod passing through the stopper of the larger vessel, but in case of fire the rod is withdrawn, thus permitting the inner vessel to topple over and mingle its contents with the bicarbonate of soda. The result, of course, is that carbonic acid gas is at once liberated. Many automatic fire-extinguishers, intended to be brought into operation by the rise of temperature caused by fire, have been used with more or less satisfactory results.

Fire Armor, a device to protect firemen and others from the effects of smoke, gas, etc. The first patent for a device of this kind given in the United States was granted to W. H. James in 1828. In this, air was supplied from the receiver worn round the waist, to a mask which enclosed the wearer's face, care being taken to prevent too great pressure from the air. Another one called the «eye and lung protector» was first used in 1873, and was adapted to protect the eyes from the effect of dust, smoke, etc., with plates of transparent mica for vision. To protect the lungs, a certain kind of porous cloth covered the lower part of the face, which held a wet sponge against the mouth and nostrils. This was used with very satisfactory results. In 1888 a method of supplying a fireman with fresh air was devised by forcing air to the fireman's mask through a pipe carried along the hose. Improvements on this plan have since been made.

Firearms, a general term for all sorts of cannon, guns, rifles, fowling-pieces, pistols, etc., which effect their discharge by the combustion of gunpowder or other explosive. They originated in the East, from which they passed to Europe, cannon being the first firearms to be generally employed. The rifle, originally invented in Leipsic in 1498, was first brought into general military use in America during the Revolutionary War. The riflemen in Kentucky, Tennessee, and the other wildernesses of the United States had long been accustomed to the use of this firearm, and so far as they could be procured, rifles were the arms of the American soldiers in that struggle. In 1813 G. H. Hall suggested that the rifle be loaded at the breech, so that the ball and powder, united in one cartridge, might be inserted without delay, and the piece loaded and fired as rapidly as the muzzle-loading smooth-bore. Hall's idea did not attract much attention in the United States. The army, for the most part, was supplied with flint-locks, and it would have involved considerable expense to change them all over. He also proposed to manufacture the locks and other pieces of the guns by machinery, so as to make the parts of the different guns interchangeable. He was employed at the government armory at Harper's Ferry to introduce the latter idea and experiment with the former. In this he was successful, and the interchangeable system was soon introduced into all the armories of the United States. In 1827 100 of Hall's guns which had been sent to Springfield in 1824 were brought back to Harper's Ferry and placed with 100 guns of current make. The 200 were taken apart, the pieces thoroughly mingled, and the guns then remounted from pieces picked up at random. The whole 200 fitted perfectly. They attracted much attention abroad, and England afterward obtained machinery in the United States, so that she might introduce the system in her factory at Enfield. Prior to 1853 every gun made in England was manufactured by hand. The percussion-cap was proposed by Shaw, of Bordentown, in 1817, and was really an indispensable part of any improved system of firearms.

The principal weapon of a new type brought out a little before the Mexican war was a purely American invention, namely, the repeater. Samuel Colt, a seaman, while on a voyage to Calcutta, devised a six-barreled revolver to be used with percussion-cps. In 1835 he improved upon this and perfected a six-barrel rotating breech. Prior to this there were two common types of pistol: one the small pistol, suitable for use on a small object at 30 yards; and the other the large horse-pistol, which was almost equal to a gun. Patents were issued to Colt for his revolver, and the manufacture commenced in 1835. He turned out 60,000 weapons a year. The large sales brought many competitors into the field, including the manufacturers of the Allen, Derringer, Volcano, Pettinger, Whitney, Smith & Wesson, and Lowell. The pistol was very much employed during the war, and many are even yet sold. Hall's idea of a breech-loading rifle was never put into general use, but in 1852, Stark, of Philadelphia, invented a breech-loading rifle that met with great success. The first of a new class of rifles to come into notice was the Spencer, the chief idea of which was applied to other American guns. This was a repeating rifle, but was almost too heavy to be successful. It was too great a burden for the men to bear in addition to their other accoutrements. The Remington, which has acquired great success, is produced at a factory at Ilion, N. Y., founded in 1825 by Eliphalet Remington. One great cause of the growth of the industry was the War of the Rebellion. The capital invested in 1840 did not exceed $200,000; in 1870 it was over $3,000,000, while at the present time it is about $10,000,000. The annual output of rifles is 1,000,000, and the same number each of shotguns and revolvers. The United States takes precedence in the manufacture of sporting rifles, metallic ammunition, and revolvers. Firearms include:

Pistol.— A small firearm having a curved stock or butt to fit the hand. Of this type there are many varieties, such as single- and double-barreled and revolver. They came into use early in the 16th century. The revolver consists of a tube, or barrel, and a revolving chamber which carries the loaded cartridges, together with the firing mechanism and handle. After firing, the loaded chamber is automatically revolved, by the action of cocking the piece, thus bringing the loaded cartridges successively opposite the barrel and firing mechanism.

Rifle.— A weapon fired from the shoulder, the stock being so formed as to rest against the shoulder when brought into aiming and firing position. The musket used to be so fired; in modern times it has been superseded by the rifle. The modern magazine gun has a much smaller bore than the old musket, and is also shorter in the barrel, yet its carrying power is much greater. This is owing to the improvements made in explosives in recent years, as well as to the rifling, or grooving of the barrel. The rifling consists of a number of spiral grooves cut inside of the gun barrel, the twist or spiral increasing toward the muzzle of the piece. This imparts to the ball a rapid spinning or rotary motion, which prevents its turning over and over endwise, and not only increases the accuracy with which it will follow the aim, but at the same time presents less surface for atmospheric resistance. The term rifle is applied to any musket or gun barrel which is grooved so that the projectile may have a rotary motion on its own axis. The rifling may be polygroove, as in the Armstrong and other guns; with only two grooves, as in some of the early weapons; with the two grooves with the angles rounded away so as to produce an

NATION	Gun	Weight		Caliber, inch	Number of rounds
		lbs.	ozs.		
Austria	Mannlicher	8	3	0.315	5
Belgium	Mauser	8	9	0.301	5
China	Lee	9	0	0.433	5
Denmark	Krag-Jörgensen	9	8	0.315	5
England	Lee-Metford	9	4	0.303	8
France	Lebel	9	4	0.315	8
Germany	Mauser	9	0	0.311	5
Italy	Mannlicher-Carcano	8	6	0.256	5
Japan	Murata	9	0	0.315	8
Portugal	Kropatschek	10	4	0.315	8
Russia	Mouzin	8	13	0.30	5
Spain	Mauser	8	13	0.276	5
Norway	Krag-Jörgensen	9	8	0.30	5
Sweden	Remington, new	8	13	0.315	
Switzerland	Schmidt-Rubin	9	8	0.296	12
Turkey	Mauser	8	9	0.301	5
United States Army	Krag-Jörgensen	9	8	0.30	5
United States Navy	Lee			0.236	5

oval and yet twisted bore, as in the Lancaster guns; or with three or more grooves, as in the most modern weapons. The grooves are of varying size, form, width, and of different degrees of twist in the length of the barrel itself, that of the Henry rifling being one turn in 22 calibres or widths of the bore. The bullet is made to fit the bore either by expansion of the base of the lead bullet, or, as in the early pattern, by having the ball "belted," so that the belt should take the groove and so emerge from the muzzle with a rotary motion.

Carbine.—A short firearm used by cavalry, similar in bore and mechanism to, and carrying the same ammunition as, the infantry rifle.

The preceding table gives data relative to the rifles used by the principal nations.

It will be noticed that the American gun, the Remington, has been adopted only by one foreign power, and that nation the rather small one of Sweden. See ARMS AND ARMOR; ARTILLERY; ORDNANCE; GUN; MUSKET; RIFLE; etc.

GEORGE H. POWELL.

Fire-back, or **MacCartney Cock,** any of the small Malayan pheasants of the genus *Acomus,* or of the Indo-Chinese genus *Lophiura,* in which the plumage of the back or rump displays glowing metallic reds. The rest of the plumage is very gorgeous, especially in the cocks, which, in *Lophiura,* are adorned with a magnificent crest. See PHEASANT.

Fire-balloon, a balloon whose ascensional power is derived from a body of heated air rising from a fire beneath the open mouth of the bag.

Fire-balls, (1) Balls filled with powder or other combustibles, intended to be thrown among enemies, and to injure them by explosion, or to set fire to their works. (2) A popular name applied to a certain class of meteors which exhibit themselves as globular masses of light moving with great velocity, and not unfrequently passing unbroken across the sky until lost in the horizon. They differ from ordinary meteors, probably, more in volume and brilliancy than in any other distinctive characteristic. They are not to be confounded with another class of meteors, that explode in their passage and appear to let fall a dull-red body (meteorolite) to the earth. See METEORS.

Fire-bar, a grate bar in a furnace resting on a frame, called the fire bar frame; inside the fire box in a locomotive engine, wedge-shaped iron bars fitted to the fire box with the thick side uppermost, to support the fire; the ends rest on a frame; they are inclined inward, with an air space between each, to promote combustion, and are jointed at one end, and supported by a rod at the other, so that the rod being withdrawn, the bars fall, and the fire box is emptied.

Fire-bellied Frog. See FIRE-TOAD.

Fire Boat, a small steamboat equipped with apparatus for extinguishing fires that may occur on the wharves or among the shipping. Used in many large cities, they have proved of great service. See FIRE PROTECTION.

Fire-brick, a brick capable of sustaining, without fusion, the extreme action of fire. They are used for lining furnaces, and for all kinds of brick-work exposed to intense heat which would melt common bricks. They are made from a natural compound of silica and alumina, which, when free from lime and other fluxes, is infusible under the greatest heat to which it can be subjected. Oxide of iron, however, which is present in most clays, renders the clay fusible when the silica and alumina are nearly in equal proportions, and those fire-clays are the best in which the silica is greatly in excess over the alumina. When the alumina is in excess, broken crucibles, glass-house pots, and old fire brick, ground to powder, are substituted for the common siliceous sand used in the ordinary processes of brick making, but which, in this case, would be injurious, as having a tendency to render the clay fusible. Fire-clay being an expensive article, it is usual, when making fire brick at a distance from mines, to mix with it burnt clay, for the sake of economizing the clay and diminishing its contraction. See BRICK.

Fire Brigades. See FIRE PROTECTION.

Fire Chief or **Marshal,** an officer in some of the larger American cities who has the supreme command of the fire department of the municipality, and who directs the work of extinguishing fires. He is generally clothed with large powers of discretion, and has also police authority.

Fire-clay is distinguished from ordinary clay by its refractoriness and infusibility, which render it an excellent material for bricks, crucibles, glass pots, retorts, and similar vessels which are to be exposed to a constant and very high temperature, at which ordinary bricks and clay vessels would fuse and become vitrified. This difference is due to the purity of fire-clay, or at least to the absence from it of iron, lime, magnesia, and alkalies, in appreciable quantities. It consists of hydrated silicate of aluminum almost entirely, but may contain traces of organic matter, and of some of the bases mentioned above. Fire-clay belongs to the coal formation, and always forms a stratum immediately below the coal. It seems, indeed, to be part of the soil on which the coal vegetation flourished and died. See also CLAY.

Fire-damp, the name given by coal miners to carburetted hydrogen or marsh-gas, CH_4. It is an inflammable gas, lighter than air, and is often found in coal mines, it being one of the products of the retarded decay of plant remains. A mixture of fire-damp and air in certain proportions is highly explosive; hence many frightful disasters with great loss of life mark the history of coal mining. See COAL MINING; METHANE; SAFETY-LAMP.

Fire-drill, a term introduced by Tylor to describe the instrument used by peoples of low culture, especially the Australians and Tasmanians, for producing fire. They take two pieces of soft dry wood; one is a stick of about eight or nine inches long, the other piece is flat; the stick they shape into an obtuse point at one end, and, pressing it upon the other, cause it to revolve quickly between both hands. By this method fire is produced in less than two minutes. See FIRE-MAKING.

Fire-eaters, in United States history, the violent, swaggering, and defiant Southern extremists before the War, threatening vengeance on Northern interferers with slavery or government interferers with the slave States. The name is used in a general sense for a blustering hot-head, especially a professional duelist.

Fire Engines. See Fire Protection.

Fire-escape, the name applied to any means of escape from a burning building. Many suggestions have been made for contriving the means of effecting this, some of them being for apparatus to be used in the interior of a building, and some to be used from without. Of the contrivances to be used within a building the simplest are a rope firmly attached to something near a window, or a rope sliding over a pulley fixed to the window-sill, and the like. And of the different machines that have been made for use from without, that which is found to be the most useful is the one invented by Wivell, and consists of a wheel-carriage supporting a long ladder with a net underneath. The ladder consists of extensions, the main ladder and the upper ladders, the upper folding over the main ladder. When used the ladder is set to the window of a building which is burning; the attendant mounts it, and assists those who are in danger to descend it.

Fire Extinguishers. See Fire Annihilator; Fire Protection.

Fire-flies, any of various forms of nocturnal insects belonging to different orders having the power of voluntary self-luminosity, usually more or less intermittent and exhibited in flashes. After the death of the insects the luminous segments, at least in many forms, can be distinguished by their paler usually yellow color which contrasts with the darker color of the remainder of the insect. The true fire-flies, commonly termed also «lightning bugs,» are found in the family *Lampyridæ,* and particularly in the genus *Photinus.* Throughout a considerable portion of our country, including the District of Columbia and vicinity, *P. pyralis* is the most prominent form of fire-fly. Farther north *Pyractomena borealis* and related species are the more common fire-flies, while a large species, *Photuris pennsylvanica,* extends from north to south. One of the most remarkable forms of fire-flies is found in the genus *Phengodes,* in which the females are wingless and larviform; the males are not luminous. The historic and poetic «glow-worm» is the wingless female of the European *Lampyris noctiluca.* In America the glow-worms are scarce, and are usually the larvæ of the genera which have been mentioned, most of which are luminous in both sexes. In other countries various other insects are reported to have the power of luminosity, among which are the lantern-flies of South America (*Fulgora lanterneria* and *candelaria*). The luminous power of the lantern-fly, however, is doubted. In Central America and the West Indies and in South America the most abundant fire-flies belong to the genus *Pyrophorus,* large snapping-beetles (*Elateridæ*), in which the luminous portions of the body are on the sides of the thorax in the form of two large pale eye-like spots. Numerous other forms of insects, including another genus of *Elateridæ,* an Asiatic buprestid beetle, some forms of poduras, the maggots of certain flies, especially of the fungus gnats (*Mycetophilidæ*), are luminous; but next after the *Lampyridæ* perhaps the myriapods are most remarkable for the possession of this power of self-illumination. The luminous or photogenic organ is regarded by Wielowiejsky and also by Emery «as morphologically a specialized portion of the fat-body, being a plate consisting of polygonal cells, situated directly under the integument, and supplied with nerves and fine tracheal branches»; while Lang, in writing of the physiology of insect-phosphorescence, briefly states that «the cells of this luminous organ secrete, under the control of the nervous system, a substance which is burnt during the appearance of the light; this combustion takes place by means of the oxygen conveyed to the cells of the luminous body by the tracheæ, which branch profusely in it and break up into capillaries.» Emery, writing of the luminosity of females of *Luciola,* states that its use appears to be a means of defense, a warning or danger signal against insectivorous animals, but there is little doubt that it also serves to attract the sexes, especially in the case of the wingless females whose powers of locomotion are so limited, while the males fly freely. Prof. S. P. Langley, secretary of the Smithsonian Institution, has made considerable study of the «cucujo» or *Pyrophorus,* as has also Heinemann, the latter reaching the conclusion that the light depends on a process of oxidation. The cucujos are the most interesting of all the fire-flies, and they are much used by the South and Central Americans in furnishing amusement for the children, while the ladies employ them as ornaments for their evening toilet, fastening great numbers of them to their ball dresses.

The literature of this subject is very extensive, but a list of important articles compiled by A. S. Packard may be found in the ‹Journal of the New York Entomological Society,› Vol. IV., 1896.

Fire Insurance in America. Although during the last half century the business of fire insurance has undergone a larger development in the United States than in any other country, it seems, when considered historically, to have been a means of self-protection, which did not readily commend itself to the judgment or confidence of our early predecessors. The expediency, not to say need, of endeavoring by means of co-operative action to minimize the individual loss and suffering incident to the destruction of property by fire made itself felt in England after the great fire in London in 1666, and there is reason for thinking that in a somewhat crude manner the practice of insuring property against possible destruction by fire had obtained years before that time in some of the countries of continental Europe. But although the early dwellers on this continent had given to them, during the 16th and 17th centuries, many serious and painful illustrations of the misfortune which came to those whose property was wholly or in part suddenly destroyed by fire, it was found impossible, before the advent of the 19th century, to arouse any general interest in enterprises of this character.

Joseph Marion, a notary public of Boston, advertised in the ‹News-Letter› of that town, on 18 Nov. 1728, his plan of «erecting an insurance office for insuring houses and household goods from loss and damage by fire by the name of the New England Sun Fire Office of Boston,» and 20 years later, in June 1748, published a similar announcement; but the public co-operation needed to make the attempt a successful one does not appear to have been given to him on either occasion. This was the earliest recorded effort made to introduce this method of co-operative protection against losses by fire to the American people. Prior to that time, and for many years after — indeed, until well into the 19th century— it was the common practice in American communities, for the friends and neighbors of a citizen whose house or shop had been destroyed by fire, to give him such sums of money as they could afford to contribute to make good the loss that he had sustained. It was realized that the calamity was one to which all were liable, and that as each in his turn might suffer from a similar visitation, the contribution given was one which would justify the giver in asking for corresponding assistance if, later on, his material possessions were destroyed in the same manner.

Judged of in the light of modern business methods this system of paying voluntary premiums after a fire for the purpose of assisting others appears to be a thoroughly unsatisfactory proceeding; but in estimating its practical value it is necessary to remember, that at that time such wealth as the community possessed was distributed with considerable evenness among its members; that there were no large aggregations of property which were liable to be destroyed by a single fire, that in these relatively small American towns the financial resources of each citizen were reasonably well known to all of his fellow citizens so that there could be no deception as to possible suffering, and that the people were much more nearly than at the present time bound together by homogeneity of race and interests. These conditions may partly explain why it was that the American people, in spite of the English experiences in fire insurance, and of their own practices of insuring vessels and cargoes against loss at sea, could not for many years bring themselves to realize the advantage to them of the system of fire insurance.

In the year 1752, under the instrumentality of a Deed of Settlement, an organization to carry on the fire insurance business was formed in Philadelphia. Benjamin Franklin was one of its active promoters. This, with a local and rival association which was soon after formed, were for many years the only regularly organized fire insurance offices in America. The business carried on by these appears to have been exceedingly limited in its dimensions, although at the time these two offices were established, there were in England quite a number of fire insurance companies carrying on an extensive business and having large financial resources.

Toward the close of the 18th century the need of some form of protection against losses by fire seems to have made itself generally evident in this country. In 1787 the Mutual Assurance Company of New York was organized for the purpose of insuring local property against fire losses. This association was formed under a deed of settlement which was drawn up, as was also the form of policy that the company adopted, by Alexander Hamilton, who was one of the directors. In 1794 the Baltimore Equitable Society, formed on the same plan, was organized in Baltimore, and in the same year the Mutual Assurance Society of Virginia was organized in Richmond. These were all mutual companies, confining their operations to the towns in which they were organized, and even in these restricting their writings to two or three of the least hazardous classes of risk. But from 1794 to 1810 the legislatures of the leading States of the Union gave permission for the incorporation of fire insurance companies on the stock plan, and in that term of years quite a number of these companies were formed in Boston, New York, and Philadelphia.

In the year 1795, after a delay of years, through failure to obtain legislative authorization, the Massachusetts Fire Insurance Company, with a capital of $300,000, was formed in Boston. This company soon after opening its office announced its intention of writing fire risks all over the United States, being in this respect the first American fire insurance company to adopt the method now in general use, of scattering its liabilities to loss by covering the widest possible area of business, a corporate policy which was adopted the next year (1796) by the Insurance Company of North America, which had been incorporated in Philadelphia in 1794. The Boston effort does not appear to have been a strikingly successful one, for after three years of active exertion the company had written only a little over 1,000 policies, or allowing for annual writing, had insured the property of not more than 400 persons. This discouraging progress led the directors of the company to petition and receive permission from the legislature to enter into the field of marine insurance as offering larger opportunities of profit, a class of business from which its Philadelphia contemporary doubtless derived much the larger part of its income. In the case of Boston in the year 1800, when the town had about 25,000 inhabitants, the estimated amount that the various fire underwriters had at risk was but a little over $2,000,000, this probably representing the conditions as they then existed in the other principal centres of population on this continent.

With the opening of the 19th century insurance companies organized to write fire risks were formed in quite a number of the business centres of this country; but for many years the efforts of their officers had to be directed to the work of explaining to the American people the advantages which might be expected to result from taking out fire insurance policies. As late as 1823, the directors of a prominent insurance company issued an address to the public in the form of a printed circular, in which they say that "presuming the subject of fire insurance has fallen under the consideration of comparatively few persons, they trust no apology will be thought necessary" for their publication. They then go on to add: "He who loses his all at sea by not insuring, instead of sympathy meets with reproach for his temerity. He who suffers by fire, although equally chargeable with rashness and imprudence, not only claims exemption from reproach, but appeals with confidence, and often with success, to public sympathy. The distress and misery resulting from this misfortune have been so often witnessed and felt, as to render it unnecessary to enlarge on the subject. It is sufficient to refer to the frequent appeals to public charity. Probably in no country in Europe is there so great a proportion of the property uninsured as in this country. There, more particularly in Great Britain, it is a very general custom to insure furniture and houses as well as merchandise and stores." It will be seen from the above quoted appeal that the need of the protection of fire insurance on business grounds was the basis upon which this now universal custom was first built. As the manufacturing, commercial and trading interests of the States increased in magnitude and value, the manufacturers and merchants were compelled more and more to have recourse for credit accommodations to the banks, which in the last years of the 18th and the early years of the 19th century were established in ever increasing numbers in all of the business centres of this country. The practice then sprung up on the part of the lenders of money of insisting that the borrower should, for the protection of the loan, keep his property insured against loss by fire. This soon came to be a common condition on the granting of credit by the banks. The merchant might be indifferent to loss by fire so far as his dwelling and its contents were concerned; but he was forced by the compulsory action of those from whom he borrowed money to protect his business property from this class of sudden loss. This banking practice was strengthened by the experiences of the great fire in New York in 1835, which destroyed fully $15,000,000 worth of property and strained to the point of insolvency the greater number of the fire insurance companies that were then doing business in that city.

During the early years of the last century the fire underwriters carried on their business, so far as official supervision is concerned, in no way different from the dealers in merchandise; but in 1837 the legislature of the State of Massachusetts passed a law, which has since been adopted by all of the other States of the Union, compelling the insurance companies wishing to do business within their respective boundaries, to first obtain authorization so to do, and second, to file with the State officials, annually or more frequently if requested, a detailed report of their financial condition, the extent of their liability, the amount of premiums received and the sums paid out in losses. It is not improbable that the experience in New York, referred to above, led to the adoption of the plan of State supervision, for that great fire made it evident that a number of the fire insurance companies had been writing risks with a freedom which indicated little or no regard for possible consequences, either to stockholders or policy holders. This form of paternalism then adopted, while in some respects safeguarding public interests, has led in other respects, as will be pointed out later on, to results which are somewhat questionable so far as public advantage is concerned. During the last 25 or 30 years the growth of the fire insurance business of the United States has been in close correspondence with the increase in this country of insurable property, and hence at present instead of not realizing the advantages of this form of protection against loss, it is probable that the American people of all classes have the destructible property that they may own better insured against loss by fire than have the people of any other country.

The business of fire insurance in the United States may be roughly divided into three classes —that carried on, first by the stock companies, second by the mutuals, and third by the factory mutuals. By far the greater part of the risks insured are written by the companies in the first of these classes. As there is no one State in the Union in which all of the fire insurance companies, both foreign and American, carry on a regular business and hence make official reports, it is not possible to determine the exact volume of business transacted. Of the State reports those issued by the insurance superintendent of the State of New York are probably the most comprehensive, and from these compilations it appears that in the year 1902 the companies that were then authorized to do business in that State, almost entirely stock companies, had written risks in the United States to the total amount of $34,000,000,000. This report of the year 1909 did not include the writings of quite a number of stock companies having their offices outside of New York, and carrying on a local rather than a general business, nor did it include, to any great extent, the writings either in New York State or elsewhere, of the ordinary mutuals or the factory mutual fire insurance companies. If these several additions were made it is not improbable that the aggregate writing in this country of all of the insurance companies during the year 1909, would be found to be between $35,000,000,000 and $36,000,000,000, a sum which must represent a very considerable percentage of the value of all the property in the United States that is liable to destruction by fire.

There were in 1909 approximately 150 stock insurance companies that reported to the insurance superintendent of the State of New York. Of these 36 were European companies that had agencies in this country and the remainder were domestic corporations. The tendency in the development of the fire insurance business in the United States appears to be toward concentration under the control of a relatively few large corporations, these located in special financial centres. During the decade of 1871–80, many more fire insurance companies reported to the New York insurance superintendent than reported to that official in 1910, although in the interval the volume of annual writings increased more than threefold. Those American companies that have the largest share in this business are corporations having their chief offices in New York, Philadelphia, and Hartford, the capitalists of the last-named municipality showing an aptitude for this class of business, as clearly specialized as is that of the manufactures of Fall River or Pittsburg.

Under present conditions a stock fire insurance company organized to carry on a profitable as well as safe business has to cover in its writings a widely extended field of operations. One of the large companies of New York which in 1909 reported the value of risks written at more than $1,000,000,000, had only a little over $200,000,000 at risk in the State of New York, the rest being scattered in thousands of cities and towns between the Atlantic and Pacific oceans. To successfully carry on a business of this magnitude and detail requires a carefully arranged organization. By the method commonly adopted the country is divided by State or sectional lines into the desired number of districts, each of which the company places under the control of a salaried official who has his headquarters at some convenient and central point in the designated territory. The duties of this manager or special agent are chiefly those of supervision. The company has its local agents, whose remuneration usually consists of a commission based on the premiums received for risks written by them.

But the desire to secure premiums, upon which commissions can be earned, may lead the local agent to take risks on behalf of his company, that the shareholders of the latter might afterward discover were far from profitable, hence the duty of the special agent is to check this possible recklessness, as his standing with his company superior is determined less by the volume of premiums that the company receives, than by its relatively small loss ratio in the district over which he exercises supervision. The risks written by the local agents have commonly to undergo the supervision of the special or general agent, and the criticism of the supervising officials at the home office before they are permanently accepted; for the ability to judiciously cancel policies that local agents have written is a factor in the line of corporate success quite equal in its results to the ability to secure desirable business.

Under existing conditions the business of fire insurance as carried on by the stock companies is largely speculative in its character. To say nothing of such tremendous conflagrations as that at Chicago in 1871 and that at Boston in 1872 — catastrophes which involved such immense losses as to completely defeat any scientific attempt to establish an average of outgo — the fire losses of the United States from year to year show wide variations. The New York State reports indicate in the experience of the companies covered by it, that the average for a long series of years has been a loss of .48-cents for each $100 of insurance written by the reporting companies, a record which cannot materially differ from the experience of the entire country. When the average loss of the different years is considered it is found that this has varied from .39-cents in 1897 to .57-cents in 1893, for each $100 of insurance that the companies have had at risk. This fluctuation is altogether too great to admit of a satisfactory scientific classification of rates. But even if the gross amount of fire loss maintained a more constant relation than it now does to the amount of insurance written, the adequacy or inadequacy of the rate charged for insuring any particular risk, or class of risks, would still rest in uncertainty because of the great variation in loss on special classes of property.

Almost all of the fire insurance companies doing business in this country keep what they term their tables of experience, upon which corporate policy is largely based. In the case of companies doing a large and diversified business, such loss records must be of great value, and yet it is well known that there is a material want of uniformity in these experiences. The records of one company may show that it has made an extraordinary profit by insuring woodworking risks, while the experience of another company, doing a business of equal magnitude and diversity, may be wholly the reverse of this, and indicate a loss ratio in this class far in excess of the entire premiums received for insuring these risks. While efforts have been made to combine the experiences of a number of the leading fire insurance companies, it cannot be said that the data thus obtained can be depended upon to do more than serve as guides for general action. A property which might for a variety of reasons be considered extremely hazardous in one place,— as, for example, a distillery in a locality where public sentiment strongly opposed the use of intoxicating liquor — might in another district be thought a highly desirable risk for a company to have upon its books. Fires occur with great frequency in consequence of human carelessness and shiftlessness, which are not only individual, but sectional in their manifestation; for as a rule, those in this country who live in the northeastern States are found to be more careful in keeping the premises that they occupy in good order than are those who live in the southern or western States. Then what may be fairly termed the element of luck enters largely into the complications, as it often happens in local experience, where two insurance companies are represented by the same agent, that the loss ratio of one will be exasperatingly high, while that of the other will be phenomenally low, although the agent may have exercised his best judgment in writing the risks for each of the two corporations that he represents. It will thus be seen that in determining the question of cost, that is, what constitutes an adequate rate to be charged for insuring a risk, the fire insurance companies cannot depend as the life insurance companies can, upon fairly well-settled bases of liability. They have nothing that corresponds in scientific accuracy to the actuaries' tables of mortality. The most hazardous risk may never burn, the one which appears least hazardous may be destroyed by fire within a few hours after the policy upon it has been issued, and there has not yet been formulated any generally accepted table of loss averages.

Life insurance companies establish a certain standard of physical health to which those to whom they issue their policy must conform. To those who successfully pass the medical examination which the life companies require, policies are issued at a uniform rate of premium. The companies thus have upon their books insurance upon selected lives, while their rates are commonly based upon the expectance of life of the entire community, including the weak as well as the strong. The fire insurance companies have in all cases their lists of prohibited risks, though there is no uniformity in these prohibitions, for in practice nearly all risks can be insured in one company or another; but they do endeavor to make the rates that they charge correspond to what they believe to be the probability of loss. This, under the most favorable conditions, is largely a rule of thumb, for though schedules for rating mercantile risks and special hazards have been prepared, drawn up as the outcome of combined personal experiences, it cannot be said that these are based upon entirely reliable data. The rates arrived at by these schedules are no doubt far superior to the personal guesses of the earlier underwriters; but they lack in a large degree the scientific certitude of life insurance rates determined by actuaries' tables of mortality. One advantage which has come from the use of the schedule system of rating, in addition to the effacement of personal prejudice in rate making, is the penalization of recognized defects in the risks thus classified.

For example, in the construction of buildings certain bad methods, such as the maintenance of vertical openings through the floors, or in the processes of manufacture the use of explosive or largely inflammable materials, can be prevented if heavy, specific charges are imposed in the insurance rates for such needless hazards. The schedule charges ordinarily made for such defects are presumably greatly in excess of the real hazard, and are intended to bring about correction, rather than an adjustment of rates to actual conditions.

These movements toward uniformity and system are only made possible by the union of the larger part of the fire insurance companies in local and national organizations. The practice of corporate combination, in agreeing on a scale of prices, seems inevitable in a business where the cost of the service rendered can never be predicted in any individual instance, and only roughly so in a great aggregation of instances. A company may receive $100 for agreeing to indemnify a property owner to the extent of $10,000 for any loss by fire that he may sustain during a year, and may not during the term of the policy be called upon for a penny of contribution, the premium in this case representing unqualified profit. But another policy, written under the same conditions, might lead to a demand upon the company for a payment a hundred times greater than the amount of the premium. Thus the speculative character of these transactions, when considered individually, is alarmingly great, and it is only by collective action that it is possible to bring them within the range of a reasonable business system. The necessity of co-operation through combination has been recognized wherever the business of fire insurance has been carried on, in the countries of the Old World no less than in the United States. In this country boards of underwriters have been organized whenever the property to be insured has been sufficient to justify the formation of more than one locally incorporated fire insurance company, or to warrant the establishment of local agencies by a dozen or more insurance companies having their corporate headquarters in other places.

The obvious reason for the establishment of these associations is the need that exists that their members should write such policies as they may issue upon a uniform and determined basis of rate. In some of the States of the Union the creation of insurance combinations for the purpose of regulating rates of premium to be charged for insuring property is prohibited by special statutes; but even in these States the paramount need of common action has led the representatives of the fire insurance companies to accept and use so-called advisory rates prepared by expert underwriters, these nominally selling their advice or opinions to those who care to buy the information. The fact that the general business of fire insurance all over the United States is limited to less than 150 insurance companies, that the largest and strongest of these corporations are members of what is in effect a national organization, make it all but impossible to effectually enforce State statutes prohibiting combinations for the purpose of regulating local transactions; while, as has already been pointed out, unrestricted competition would lead, from the highly speculative character of the business, to very general corporate insolvency.

The large and well established companies that have premium incomes of millions of dollars a year upon which by investment interest can be earned, are in a much better position to carry on the fire insurance business than are the newly organized companies that have not and cannot for years expect to obtain these large incidental sources of revenue. This tendency toward monopoly is strengthened by the now usual system of State supervision, which places a serious handicap on efforts to form new and competing companies, by imposing conditions on these which ordinarily lead to a more or less speedy impairment of capital, a result which is held to justify the public authorities in compelling the companies thus afflicted to discontinue issuing policies. Thus, while the insurable property of the country is constantly increasing in amount and value, while most of the well established companies have greatly enlarged their net assets during the past decade, the number of stock fire insurance companies has not increased and such attempts as have been made to establish new companies have commonly ended in failure.

From the New York State reports referred to above, it is found that for a series of 43 years, from 1860 for 42 years, the loss rates of all of the reporting companies was 58.87 per cent of their premium receipts, though this included the two great conflagrations of 1871 and 1872. The expenses of the business during the same term of years were 35.12 per cent of the premiums, and the rates of dividend paid to the stockholders of the American companies were on the average 11.14 per cent on the capital of these corporations; this representing a liberal return, when it is taken into account that many of the successful companies have, in addition, set aside large sums of money to increase their surpluses. It is quite possible that the annual expenses (not losses and dividends) of the 594 stock and mutual companies of the United States, amounting to $116,000,000, is excessive, and that in time this will be cut down, as it represents a great many million dollars paid out in commission to brokers, who in modern business economy may be looked upon as needless factors, and who would doubtless be dispensed with, if it were not for the competition to get business that now exists between the companies. The amount of fire premiums received by these companies in the year 1910 was $328,957,313. The amount of risks written that year approximated $34,000,000,000. The fire losses paid by these companies for the same year amounted to $154,099,782.

It is the business practice of all of the companies that insure fire risks in this country to insist that the assured shall either insure his property to eight tenths of its value or shall pay an increased rate for the protection that his policy gives to him. This rule does not, however, apply to dwellings and their contents which are ordinarily considered an exceptionally desirable class of property to insure.

The usual term of a policy is one year. If written for a shorter time the rate charged is considerably higher than what would be the pro rata of the annual rate. In the case of buildings, and dwellings and their contents, it is often the case that policies are written for a term of five years, the rates in these cases varying, according to local custom, from three to four times the annual rate. In Philadelphia, and possibly elsewhere, the custom has been in use for many years past of insuring dwellings by what are called perpetual policies, the company insuring these agreeing, in consideration of a capitalized payment of premiums, to insure the property forever without calling for a further contribution on the part of the assured.

When compared with other countries the aggregate of annual fire loss in the United States is exceedingly large. Although there are not accurate statistics either here or elsewhere, it is safe to say that the yearly fire loss of this country is greater than the combined fire losses of the United Kingdom, France, Germany, Austria and Italy. This exceptional experience is due to our defective building laws, to the poor enforcement of those that we have, to the greater recklessness of our people, and to the tendency to accumulate large values in merchandise in buildings of great and undivided areas, thus permitting one fire to damage or destroy property worth enormous sums of money. That this record of loss is to quite a degree needless, or at least preventable, is shown by the experience, given later on, of the factory mutual fire insurance companies. So far as the influence of the underwriters connected with the stock fire insurance companies of America has been brought to bear in the direction of reducing fire losses, it has been of public value; but it is possible that collectively they have not yet exerted themselves along these lines to the extent that they might or as they may find it expedient to in the years that are to come.

Considered in its broader aspect, all fire insurance is carried on upon the mutual basis, for the stock companies do not intend to pay fire losses from their capitals, which are held as reserves to meet some great catastrophe. The stock underwriter collects premiums from a large number of property owners and uses these for the purpose of paying the fire losses which come to a few of those whom he insures. Under the purely mutual system the companies have no capitals belonging to stockholders, for all of the corporate assets are the property of the policy holders for the time being, who when they take out their policies obligate themselves to pay upon demand, in addition to whatever premium they then pay, such further sums as may be necessary to make good their share of any exceptional loss that the company may sustain, this contingent liability being usually limited so as not to exceed two, three, or four times the sum of the original premium. If the business transactions of the company are carried on upon a low loss ratio, the profits, after deducting the expenses and salaries of the company officers, are paid back to the policy holders in proportion to their original premium contributions.

This is an entirely equitable method, and when the business carried on is confined to isolated risks of a non-hazardous character, the result has frequently been eminently satisfactory. By this means the expense of fire insurance has been reduced to what it has actually cost, and when limited to a few classes of risks, such as dwellings and their contents, or unexposed buildings occupied for stores and dwellings, it has been possible to establish rates of premium which have been reasonably fair to all participating policy holders. When, however, the mutual method has been more widely extended, so as to take in a great variety of risks, the possibility of very large losses, and the uncertainty of whether each policy holder has contributed his fair and proper share to the general fund, has militated against the efficacy of the plan, and in many instances has brought about the bankruptcy of the too adventuresome corporation. There are successful companies of this mutual type to be found in all parts of the United States, but for obvious reasons their range of business is greatly circumscribed.

The system of fire insurance applied by the so-called factory mutual companies is a distinctly American outgrowth of the ordinary mutual method of providing indemnity for fire losses. The first company of this type established was the Providence Manufacturers' Mutual Fire Insurance Company, which was incorporated in 1835; but there are now 19 companies of this class in the eastern section of the United States, and others which somewhat correspond to them in the South and in the Mississippi valley area. These companies were the outgrowth of the belief on the part of certain manufacturers that the stock companies were charging for insurance protection unwarrantably high rates, and that it would be better for these manufacturers to try the plan of insuring each other. If they had restricted their services within the then understood range of insurance work, their operations would not have been attended with material consequences. But from the outset, and with increasing earnestness as time has gone on, the officers of these companies have insisted, that the duty of paying fire losses was only one, and the less important function which these companies had to perform, and that the work of preventing fire losses was the service to which attention should chiefly be given.

The results which a consistent enforcement of this theory have secured, have been unparalleled in the experiences of fire insurance, either in this country or elsewhere. The risks protected by the policies of the factory mutual companies would be ordinarily classed as specially hazardous. Cotton, woolen, and paper mills, rolling mills, iron foundries, and the like, are not hazards that the stock underwriter ordinarily views with favor, and yet as the result of thorough, periodical inspections, of bringing to the attention of the manufacturers the advantages of certain improvements and of securing the cooperation of the latter in introducing and applying these, the probability of fire loss in these risks has been brought down nearly to the level of the fire hazard in ordinary dwelling houses. Risks written by stock and mutual companies in 1909 amounted to the gross sum of $34,000,000,000, and on these was paid a fire loss of $154,099,782. The experience of some of the companies was relatively better than would appear by this showing. Thus the Boston Manufacturers' Mutual Fire Insurance Company, of which Edward Atkinson is president, gave their average cost of insurance per $100 per year for the three years 1900–02, at 7.36 cents. The significance of this showing is brought out by recalling that while practically all classes of property in this country, as determined by insurance rates, are much more liable to fire loss than similar property in Europe, the mills in the United States under the factory mutual system show a smaller average fire loss than any similar risks in any other part of the world.

The obvious deduction to be drawn from this showing is that by combining fire insurance with supervision of risks it is possible to reduce the enormous fire waste of the United States to reasonable proportions. The lesson taught by the factory mutuals has not been overlooked by the stock companies, which have, when it has been possible, applied a similar system of inspection to the risks which they have written. The disadvantages which they labor under are that risks which they take are not usually under a single control or ownership, are not isolated or unexposed by other hazards, and in most instances have such a restricted value that the entire fire premium would not be sufficient to pay the expense of careful periodical inspections. But with the larger risks the system of frequent inspections is quite generally applied, while the increasing use of automatic fire sprinklers — the most effective fire preventive device ever invented — and the scientific regulation upon safe principles of all new mechanical devices by the Underwriters' Laboratory which the stock companies have established, give promise that in the future the needless losses by fire will be greatly reduced in number and volume to the great ultimate benefit of all classes of insurers.

OSBORNE HOWES,
Boston Board of Fire Underwriters.

Fire Island, the most westerly end of a strip of the Great South Beach, Suffolk County, New York, 40 miles long, averaging one half mile wide, off Long Island, between Great South Bay and the Atlantic Ocean. It is reached by ferry from Babylon. The beach took its name from the fires built there as signals to vessels during the war with England in 1812. Between the beach and the mainland, in Great South Bay, are five small islands. About 45 miles east of the inlet to the bay Great South Beach joins the mainland. The entire strip is dotted with popular watering-places; the air here is said to be a specific for hay fever. There is a large hotel on Fire Island Beach, and within a few rods to the east a lighthouse 185 feet high with a revolving light. Margaret Fuller Ossoli, her husband, and child, were drowned on this beach 19 July 1850.

Firelock, a musket or other gun, with a lock furnished with a flint and steel, by means of which fire is produced in order to discharge it; distinguished from the old matchlock, which was fired with a match. See MUSKET.

Fire-making, the art of producing fire. It was believed by the ancients that man was without fire till Prometheus stole some from the chariot of the sun, but the whole story has a mythical look. Plutarch says that in his time there were fireless races of mankind, and the geographer Pomponius Mela indicates Ethiopia as the locality of one of these. A certain Eudoxus, however, taught them how to produce it. This story cannot be tested now, but Edward Tylor, after passing in review the alleged modern instances of fireless races, rejects them one and all. He believes that there was a time when man was without fire, but it now everywhere appears to have passed away. The oldest method known of making fire is the South Sea Island one by means of a stick and a groove. There followed next, it is believed, the method of striking fire by means of a flint, a piece of iron pyrites and tinder. This process was known to the ancients, which is the reason why they called one of the two minerals used pyrites — that is, fire-stone. The Greeks, in the time of Aristophanes, knew how to concentrate the sun's rays by a burning-glass, and the Romans in the age of Pliny (23–79 A.D.), effected the same result by concave mirrors. In the case of the need-fire, a superstitious rite connected with sun worship, and of which an instance occurred near Perth as late as 1826, fire was obtained by the revolution of a windlass in the hole of an oaken post smeared with tar. The preceding generation remembered the time when fire was obtained by flint, steel, and a tinder box, till superseded by the lucifer match.

Fire Philosophers, certain religionists, who in the 16th and 17th centuries attempted by the aid of fire to penetrate to the primary elements of things. They attributed little to human reason and reflection, but nearly everything to experience and divine illumination. One of the most notable among them was Jacob Boehme, a shoemaker, of Gorlitz, whom his patrons called the German theosophist. He lived in the 17th century. The others were also called theosophists.

Fire Protection, the means employed toward extinguishing fires once they are under way, which is quite distinct from avoiding the outbreak of fire, the latter being termed «Fire Prevention.» The scourge of fire has been feared, and combated by different methods, and with varying degrees of failure and occasional success, since the early ages. Water has been the almost universal extinguishing medium employed. In fire protection the theory of combustion is an important matter for consideration. A substance «burns» when its temperature has been raised to or above its ignition point and provided it is in the presence of sufficient oxygen to support the combustion. The burning of all so-called inflammable substances, or those having a comparatively low ignition point, acts to quickly raise the temperature of similar adjoining substances to a point where they in turn burn, thus continuing or spreading the fire. In fires which concern the protectionist, the required oxygen is supplied from the air, and combines with the inflammable substances at their varying ignition points. The resultant chemical action produces heat and fire results. This action also produces gases which, when burning, constitute flame, the smoke consisting of particles of the material which have not been consumed, which are borne away by the hot air currents. In subduing a fire, one of two courses may be pursued, namely, to reduce the temperature of the material below its ignition point, or to exclude the air. The importance of checking the spread of fire in its early stages cannot be overestimated, and to-day all intelligent effort is directed to this end; otherwise, such an amount of combustibles may become afire at one time as to quickly overtax all fire fighting facilities which the most prodigal would provide. To illustrate: one pound of wood fuel will evaporate about one gallon of water. There are in this country innumerable buildings, each containing tons of combustible material, and, should a considerable part of any such building and its contents become afire, it can be readily seen that the thousands of gallons of water per minute necessary to reduce the temperature of the mass below its ignition point would seldom be available, particularly if combated through hose streams, as it is generally conceded that but a small portion of the water thus thrown ever reaches the seat of a fire. This waste is variously estimated at from six tenths to nine tenths of the water discharged. The loss of efficiency is due to the impossibility of approaching closely to the seat of a fire once it has gained good headway. Smoke, heat and flame prevent by holding the fire fighters at a distance and by concealing the precise location of the fire; yet the water must penetrate the smoke and flame and reach the heart of the fire before the temperature can be reduced sufficiently and the fire extinguished. It is, therefore, important to bend every energy toward assailing the fire during the early moments of its existence, and to realize that many buildings once thoroughly aflame cannot be saved by the most powerful facilities known. In such events, the fire department's chief occupation must be the saving of adjoining properties, thus preventing spread of the fire. Conflagrations and large fires represent conditions where blame should attach for allowing a state of affairs which makes them possible, rather than that they are not successfully combated when once under way. In the United States, the inflammable construction and large areas of buildings have compelled advanced fire protection, which is particularly noticeable in the highly organized, quick acting public fire department, and the even more rapid automatic sprinkler equipment — the latter is the most efficient known method of fire fighting. Both systems have received their chief development in this country.

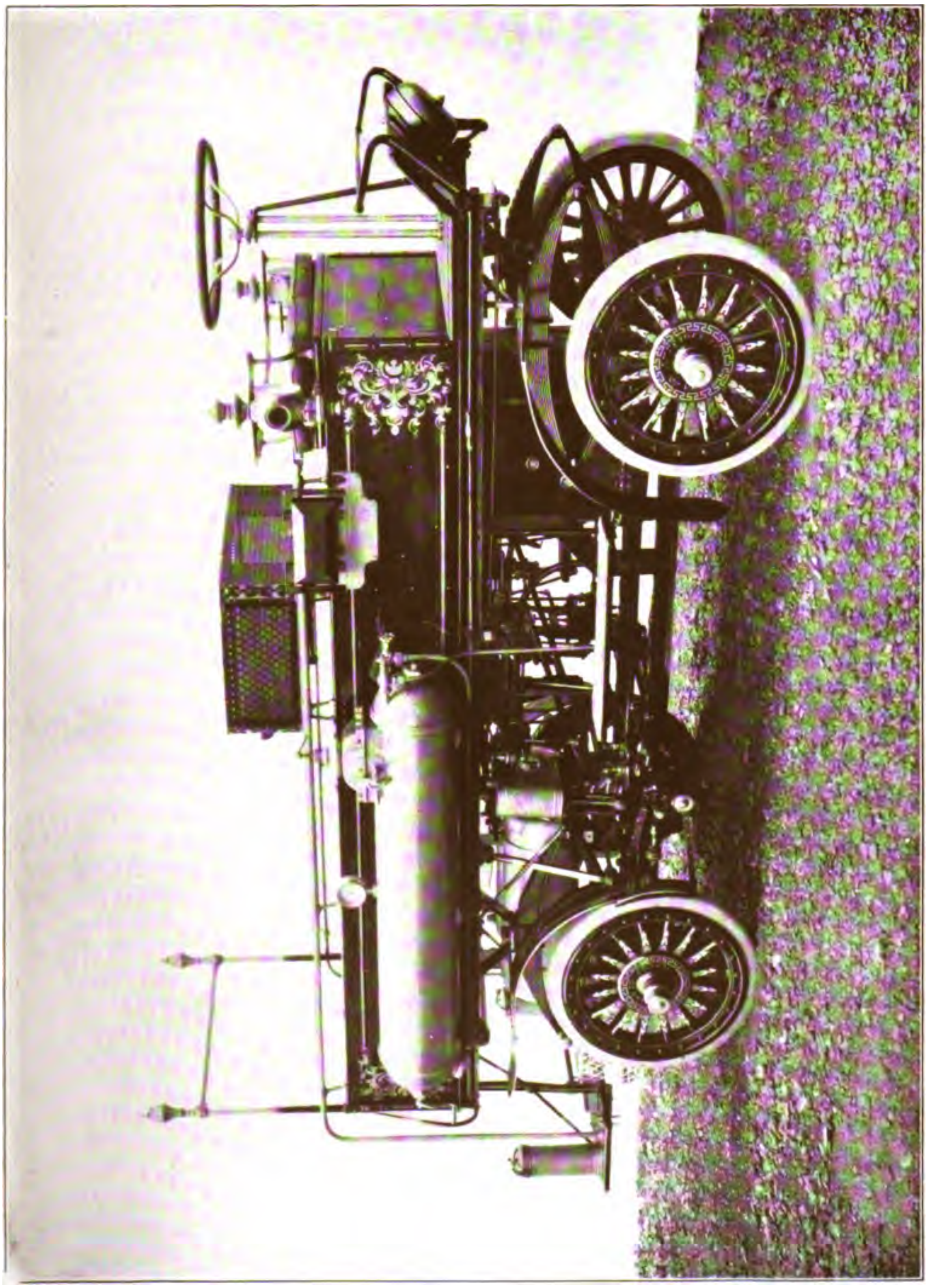
Up to the 18th century, special and efficient types of fire apparatus were not in general use. It is true that Hero, about 150 B.C., describes the construction of a small two-cylinder, single-acting, hand-brake, force-fire-pump, and Pliny speaks of force pumps used in fire extinguishment. Apparently, such pumps were little used, but their early origin is most interesting. Syringes, or "squirts" discharging water — some of them large enough to require several men for operation — seem to have been used by the ancients and up to the 19th century. Chemical extinguishers of slight efficiency were used in the 18th century, as for instance, hollow clay balls containing powdered alum and a charge of gunpowder connected with a fuse, all of which was to be thrown into the fire. The hand-pump, draughting from a trough of water, mounted on wheels, was in use in England, Germany, the United States, and elsewhere during the middle and latter part of the 18th century, and represented the first machine of importance, having an extinguishing power radically in excess of the public bucket brigade. This type of apparatus was developed into the well-known hand-brake, which was the immediate forerunner of the modern day steam fire engine. The first of the latter was built in London 1829, and the first in the United States in 1853.

In all this time water has constituted the only extinguishing means of any importance and has been put into use chiefly by the hand-pail or bucket, the hand-pump and the stationary or mobile steam-pump.

It should be pointed out that all devices and materials used for fire extinguishment, many of them consisting of more or less complicated mechanism, possess the great disadvantage of not being in constant or daily use, as is, for instance, the machinery of a mill used in the daily production; and when called upon are liable to be used immediately, without time for preparation and up to the maximum efficiency,— perhaps also by those unskilled in their manipulation and laboring under excitement. It is, therefore, necessary that all such be designed and built, not only in a manner which would be adequate under normal working conditions, but with a much wider margin of safety and excess of strength and excellence to provide for such abnormal demands. It is important that proper rules be framed for the construction, installation and care of all fire protection devices, and, in the United States this work, so far as private fire protection is concerned, is carefully specified by the National Board of Fire Underwriters, who maintain extensive laboratories for such purpose.

Public fire departments have been developed in this country to a remarkable degree. The scope of the organization and the types of apparatus to be employed are to be determined by the area, height and character of the buildings to be protected and the nature of the water supplies available. The apparatus of a public department usually consists of steamers, fire hose and play pipes carried on carts and laid in folds for quick removal, ladders for gaining access to the various floors and roof of a building from the exterior (these include extension ladders operated by hand, hydraulic, steam and electric power), chemical engines drawn by horses and discharged through lengths of hose carried into a building in same manner as the larger hose streams from the steamers, hand chemical extinguishers of the carbonic acid gas type, water towers for projecting powerful hose streams within a building from points opposite upper story windows, and also numerous and varied minor and subsidiary devices. All effort is made to bring the department into action on the scene of the fire at the earliest possible moment, to which end are used the electric fire alarm systems, both automatic and manual. Quick hitching apparatus is employed for almost instantaneously adjusting harness to the horses in the houses in which the apparatus is maintained. The horses are trained to take their places at the pole on alarm of fire, at which time an electric device releases their stall fastenings. The main doors are opened by the operation of a release mechanism, and the firemen sleeping on the floors above the apparatus have their garments so designed and arranged that, in event of a night fire, they can clothe themselves almost instantly, and, descending to the main floor by sliding poles, take their positions on the apparatus and emerge from the house in a few seconds. In thus promptly reaching the fire, and giving it little chance to extend beyond the point of control, our public fire service deserves greatest credit.

One portion of the apparatus above mentioned must be specially pointed out as regards its efficiency. From 50 to 75 per cent of the fires of record controlled by public departments are to-day extinguished by the small chemical engine, whose great efficiency in the hands of a



AUTOMOBILE CHEMICAL ENGINE AND HOSE CARRIAGE.

fire department is due to the fact that the apparatus is light, and in responding to a fire is prompt in arrival. The hose is small and easily handled under the extra high pressure which prevails and hence is the first to be taken into the building, reaching the scene of the fire early enough in most cases to bring about the remarkable percentage of successes above noted.

Discipline and thorough training and organization of a department are of utmost importance, and it is a great regret that these do not prevail in all places. The rank and file of American firemen are well above the average as regards bravery and intelligence, but can never be brought into a satisfactory state of efficiency until politics have absolutely no influence in the organizations.

Pails.— Galvanized iron, of 12-quart capacity, are generally used, either round or flat bottom, the round being designed to prevent the pail being set down on the floor or commonly used, that it may thereby be reserved for fire purposes only. Metal covers may be used to keep out lint or dirt. They are to be hung on posts or set on shelves at frequent intervals throughout a room and kept full of clean water. In places where quantities of paints, oils, grease, etc., are used, or in electric stations, at least a portion of the pails are to be filled with dry sand. Complicated sealed-top pails filled with unknown solutions are not advised. Fibre pails or wooden pails are not apt to last as long or be as desirable as those above recommended.

Casks.— Stout wooden or metal casks to hold a reserve supply of water are useful in conjunction with pails or buckets. A quantity of lime may be slacked in such barrels, and common salt dissolved therein to retard fouling in hot weather, or freezing during the cold months.

Flexible hose as used for fire protection was invented by Jan Van der Heide, of Amsterdam, in 1672. It was made of leather with sewn edges. About 1808, a Philadelphia manufacturer improved this method by using copper rivets in lieu of sewing the seams. Fire hose of hemp was made in Germany in 1720. Leather was, however, generally used until rubber hose was introduced in England in 1827, and for many years after until replaced by the modern woven, or knit-cotton, rubber-lined hose. For private hydrants, 2⅝-inch cotton rubber-lined hose of best quality should be used. The underwriters' requirements enter into most minute particulars as regards the construction of this hose, and only that tested and "approved" should be purchased. For public fire department use, hose of 2½-inch to 3-inch, either cotton rubber-lined, extra jacketed, or the all rubber type is used, as this hose is subject to rough and frequent usage. Hose used within a building on standpipes should be of best quality woven linen, from ¾-inch to 1½-inch in diameter, frequently connected that lengths may be short. Smooth bore brass nozzles of ¾-inch diameter should be used for this hose, and it is preferred not to connect large diameter hose within a building, the small, so-called "hand-hose" being light and easily manipulated by the inexperienced even under high pressure, and if abandoned, as inside hose often is, does not leave a large quantity of water running to waste. Play pipes for 2½-inch hose and larger should have perfectly smooth tapering tubes, and there are precise specifications for the underwriters' type, which, briefly described, is 30 inches long, wound and painted, has swivel handles at its base, and is provided with a 1⅛-inch smooth bore tip or nozzle. In places where the temperature falls below freezing even for a short time and at rare intervals, only the best quality frost-proof hydrants should be used, these to be of "post" pattern, that is, extending above the ground where they are instantly available for operation and hose connection. The refinements of hydrant construction are specified by the underwriters, and a material improvement in their construction is being effected at the present time. Water discharge outlets, called "monitor nozzles," connected directly with the supply piping without the intervention of hose are often advised, as at roof locations. They are arranged to be revolved by hand and the nozzle raised or lowered. For most practice, tar-coated, cast-iron pipes should be the only type used for underground work. Wrought-iron pipe when laid underground, deteriorates much more rapidly, aside from being more difficult to keep tight at the joints. Much cast-iron pipe on the market is imperfect, and very likely has been discarded by large purchasers who make careful tests. It is, therefore, important that such pipe should be most carefully specified and built in strict conformity with the requirements of the underwriters. Furthermore, much good pipe is injured in shipping or unloading, and, perhaps the most important feature of all is in laying and calking, which should always be entrusted to men experienced in this line of work. All such pipe systems should be submitted to a searching hydraulic test after completion, the precise procedure for which is minutely laid down by the underwriters.

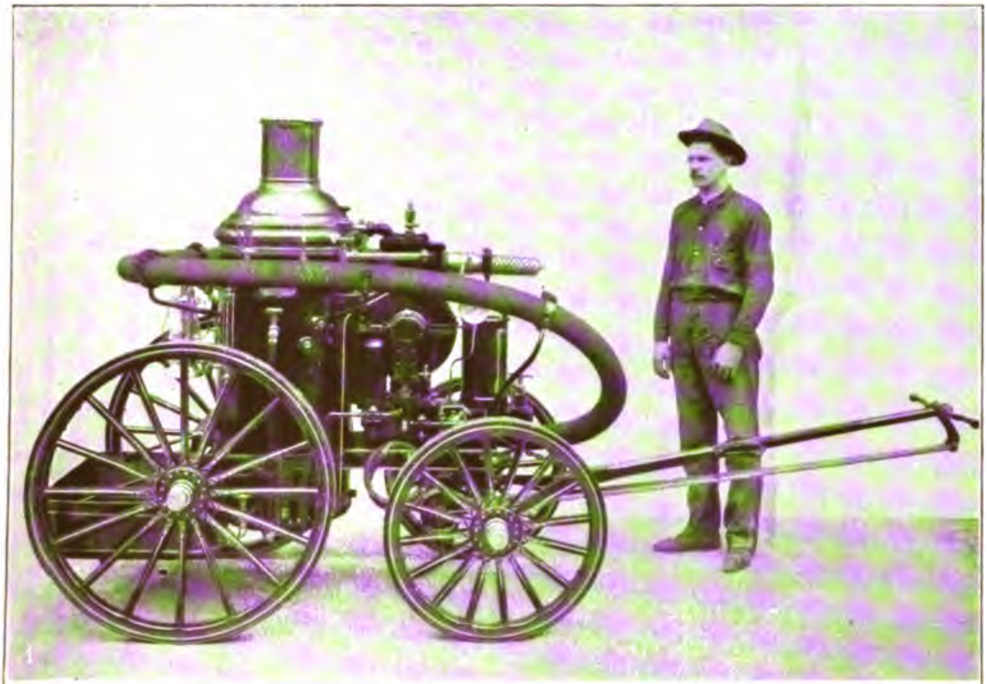
Public Water Supplies.— The most reliable and satisfactory method of obtaining water for extinguishing fires, either through the medium of hose streams or automatic sprinklers, is the reservoir, inexhaustible under both domestic and fire consumption, of unfailing supply in season and out, and of sufficient elevation to give the required hydraulic head. Many buildings in a majority of towns, villages and cities require for satisfactory service a pressure of not less than 75 pounds at grade, this pressure to be taken with the water flowing. A standard hose stream for general use is one flowing 250 gallons per minute through a 1⅛-inch smooth nozzle. It is important that the number of full-capacity hose streams necessary at any one time be predetermined and their existence or non-existence established by actual test, namely: Flowing water simultaneously through the required number of streams to determine whether under such conditions the pressure requisite can be maintained. Such a supply not being available in a majority of instances, recourse is had to one of the following systems: Gravity supply from elevated reservoir or standpipe of limited capacity, fed by pumping engines, direct pressure service from pumping engines, or a combination of gravity feed and direct pressure. It often occurs that a gravity supply is adequate for domestic purposes, but the pressure therefrom needs to be radically increased in time of fire by pumping directly into the mains, or, it may be that the pressure from gravity supply is adequate for a portion of the town, but that, due to area and height of buildings or elevation of land, high pressure is required for another portion. It is manifest that a gravity supply is more reliable than supply from pumping engines, other conditions as to pressure and quantity being equal. This is due to the occasional necessary interruption of pump service and holds true except where a number of separate pumping units are maintained, each adequate to the service required. An important precaution rarely taken is the location of such pumps in strictly fireproof buildings and where not subject to damage by exposure to fires. The modern city building of excessive height and area has created a demand for fire protection and water supplies not previously contemplated and which existing systems are quite unable to meet. This is being provided for by special high-pressure pipe lines, often of special design to provide against leakage and breakage, fed by pumps capable of discharging their rated capacities at high pressures, generally at about 300 pounds. Such systems are now to be found in Boston, Buffalo, Chicago, Cleveland, Detroit, Milwaukee, Philadelphia and Providence. In most cases the fire boats serve these mains, but in Philadelphia there is a fireproof pumping station in which numerous force pumps, each operated independently by its individual gas engine, are located. This station is used only for supplying the high-pressure fire service, at about 300 pounds pressure. The pipes for this system were submitted to a foundry test of 800 pounds per square inch. The use of gas engines for this purpose is a novelty, and have been resorted to for economy of maintenance as compared with the steam plant. The gas engines can be started to full capacity in a few minutes, and, as this high pressure service will be called upon but a few times per month, it will be seen a material saving is effected in cost of maintenance. Salt water from the sea is desirable for fire extinguishing purposes, and has theoretically a slightly greater fire extinguishing value. Being a never failing and inexpensive source, it should wherever available be made use of for high-pressure fire service systems.

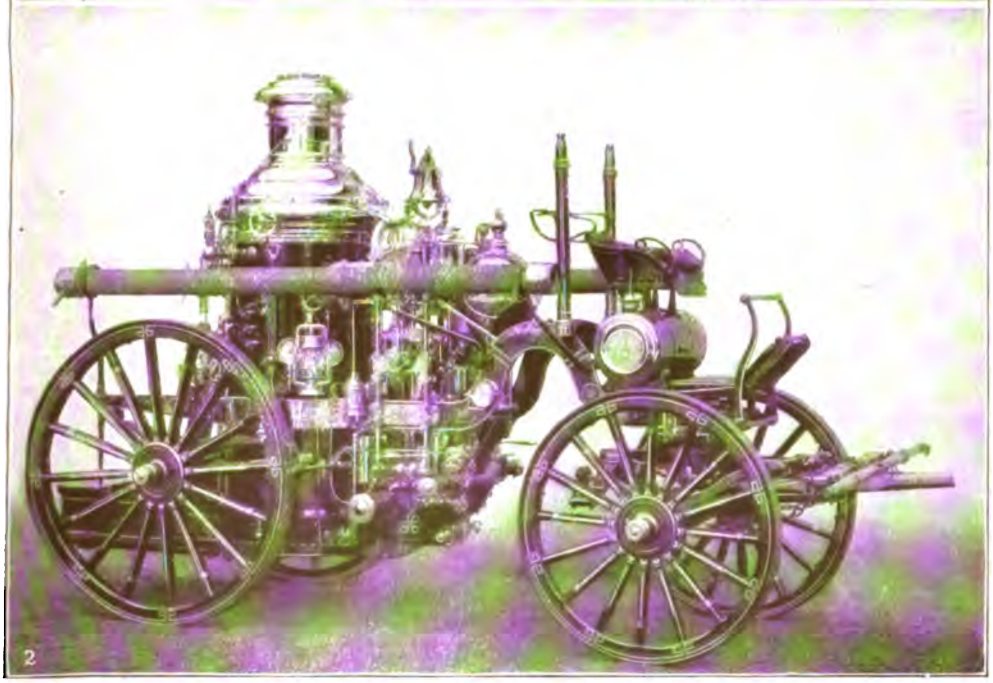
Steam stationary fire pumps for factories and private protection generally, should be duplex, and of the type which is most carefully specified by the underwriters. While these pumps may not be economical for constant service — they are not built with such intention — they will be found staunch and fully efficient for an emergency run at time of fire. They are generally made in four sizes and are rated according to the number of gallons to be discharged per minute under average conditions, namely: 500 gallons, 750, 1,000, and 1,500. Where larger capacities are desired, they should be secured by the use of two or more such pumps. Special care is taken in their design to have the areas and passages of ample size and to make the pump proof against such rust as could cripple its operation and of substantial design. Automatic governors can be inserted in the steam supply of such pumps, causing the pump to maintain automatically a predetermined water pressure in its discharge pipe. A more modern arrangement for this purpose is a small pump auxiliary to a larger fire pump, each fitted with an automatic regulator, but the smaller one set at a higher point so that it takes up all of the slip and wear and tear of operation except in event of fire, when, unable to maintain the pressure in view of the increased demands, the larger pump comes into play for such purpose. Portable steam fire engines are commonly used to provide pressure and quantity of water desired for fire streams when both these factors are not found existing in the public water service. They are called "steamers," being designed to very rapidly "get up steam" sufficient to operate the engines driving the water pumps. Their capacity per minute is commonly rated as follows: 1st class, 900 gallons; 2d class, 700 gallons; 3d class, 600 gallons; 4th class, 500 gallons; 5th class, 400 gallons. They are generally drawn by horses, although a number of steam driven machines have been in satisfactory use for many years. In such machines, by a change of gearing, the engines used for propulsion are, upon reaching a fire, disconnected from the running gear and used to operate the water pumps. They are built to discharge as high as 1,400 gallons per minute.

To bring the water to the seat of fire from the source of supply with as little friction loss as possible, much care is required, not only in having the pipes of sufficient size, but also that they shall be fed at proper points and connected in a general net-work or "gridiron" to prevent dead-ends. It should be clearly borne in mind that the very frequent location of hydrants is, in the long run, very much less expensive than the reverse policy, as the latter would involve the purchase and maintenance of much larger supply of hose, the latter being perishable and costly. The greatest amount of expert supervision is necessary in the laying of such pipe systems that they shall be correctly installed so as to give a minimum percentage of leakage, to prevent foreign matter entering the pipes while being laid, and constant care is required thereafter that buried gate valves may be kept wide open and all portions of the system free from obstructions.

Fire Alarms.— During 1852, in Boston, the first fire alarm was transmitted electrically from a central office to the nineteen tower bells of the city. Two years previous the Morse telegraph had been used in New York for sending notice of fire from police stations and engine houses to watchmen stationed in bell towers. The modern system consists of numerous street boxes which can be instantly operated by any citizen who desires to announce a fire in the vicinity. This alarm is electrically transmitted to a central station, and from that point to such of the fire department houses as should respond to a fire in the district indicated. Thermostat or automatic fire alarm systems are now extensively introduced and extend this principle of electric fire alarm transmission into and throughout a building. The thermostats, which are small devices for opening or closing an electric circuit as the case may be, are distributed about on the ceiling and wired up to a certain point where they are connected with gongs for the local announcement of fire or direct connection is made with the central station through which the public department is summoned. These thermostats are commonly set to operate at some 150° F. It will, therefore, be seen that they can be affected by the heat rising from a very small fire, and thereby summon the department, perhaps a mile distant, who often arrive upon the scene while the fire is still small enough to be extinguished by a few pails of water.

FIRE ENGINES.





1. Small Fire Engine for a Country Place.
2. Engine for a City Fire Department.

Open Sprinklers.— Where it is desired to wet down the exterior surface of a roof or side wall of a building to guard against heat from exposing fires, an arrangement of open sprinklers may be provided, consisting of piping to which open valve sprinklers are attached, the piping being fed by the water supply normally kept out of service by a closed gate-valve, which, in event of need, is opened by hand, and the water allowed to issue from all of the open heads. This is found to be an efficacious arrangement where ample water supply is available and exposure is not excessively severe.

Chemical Extinguishers.— The use of chemicals for extinguishing fires has received a considerable amount of attention from ancient times to the present day, yet it is only recently that a successful and reliable type of chemical extinguisher has been upon the market. Numerous so-called fire extinguishing solutions or compounds, claimed to be of mysterious and wonderful power, have been placed before the public, and frequently it is claimed that such a revolutionary extinguisher has but just been «invented.» The chemical salts and gases which tend to extinguish fire are well known, and are not likely to be invented at the present day. They consist of the following: Alum, soda, borax, hyposulphite of soda, silicate of soda (water glass), chloride of lime, tungstate of soda, chloride of tin, sulphate of ammonia, chloride of ammonia, sulphate of soda, nitrate of soda, chloride of sodium (common salt), potash, bicarbonate of soda, and ammonia.

To-day the only generally recognized chemical fire extinguisher is the so-called carbonic acid gas machine. It consists of a cylinder, usually of copper, containing bicarbonate of soda dissolved in water, also a bottle containing sulphuric acid. Arrangement is made whereby the contents of the bottle may be emptied into the soda solution thereby instantly generating carbonic acid gas which serves as a propelling agent to eject the soda solution at the cylinder outlet at which point hose is attached. The proportions of acid and soda are arranged so as to allow an excess of the latter. The effectiveness of the stream is, therefore, due to the water discharged on the fire under high pressure, averaging at the start 100 pounds or more; to the carbonic acid gas which, to a considerable extent is carried along with the jet of water, and also to the sulphate of soda deposited by the water jet and which tends to form a crust over a burning surface, this in part excluding the air. The 3- and 5-gallon machines of this type are designed for individual use, 40-gallon machines on wheels are employed for the protection of private property, while the larger 80-gallon machines are the most efficient weapon of the public fire brigade.

Automatic Sprinklers.—Automatic sprinklers afford the most efficient known means of fire protection. They are operated almost immediately by heat from the fire which they are destined to extinguish. This prompt action checks the fire at its incipiency and confines the water to that portion only where it is required. Such effectiveness is in theory and practice all that can be desired. An automatic sprinkler is a small device for distributing water having a valve arranged to be released by action of heat, as from a fire which it is intended to extinguish. The sprinklers are screwed into the outlets of piping, the latter suspended on the ceilings of rooms and filled with water under pressure. It is essential that the sprinklers shall be so located that distribution of water therefrom will cover all portions of the premises; that the piping shall be of sufficient size; that the water supply be of sufficient quantity and pressure and automatic at all times; and finally, that such systems be kept under regular and intelligent inspection. The first device of this nature was patented in England in 1723. Sir William Congreve, in 1812, invented a sprinkler which he described as follows: «An apparatus for extinguishing fires which shall be called into action by the fire itself at its first breaking out, and which shall be brought to bear on the precise spot where the flames exist.” Major Harrison, an Englishman, in 1864, invented an improved sprinkler and drew up details for sprinkler installation. In 1874 Henry Parmelee, of New Haven, Conn., patented and installed an automatic sprinkler which was the first practical device of the kind. It was, however, not sensitive, inasmuch as the release joint was in contact with the water which filled the sprinkler and the pipe system. Another step in the art, and one of great importance, was the invention of Frederick Grinnell, of Providence, R. I., in the making of a thoroughly sensitive sprinkler which he did by isolating the location of the release device so that it quickly felt the heat of a fire and operated most promptly. Mr. Grinnell's patents also included a diaphragm valve seat which was self-tightening under increasing water pressure, and also the Grinnell differential dry pipe valve, which devices have since been generally used throughout the civilized world. Realizing the importance, underwriters have made specially exhaustive rules governing the installations of automatic sprinklers, and most carefully test and examine all devices used in such equipments. The installation of a sprinkler equipment in full conformity with the detailed underwriters' rules is a trade in itself. As a basis for the rules, it is required that each automatic sprinkler have an unobstructed outlet of such size and form that, with five pounds pressure maintained at the sprinkler, it will discharge approximately 12 gallons per minute. This is very nearly the discharge through a ½-inch circular orifice in a thin plate. The size of the piping to which the sprinklers are attached is graduated with this discharge per sprinkler as a basis, and also on the assumption that a limited number of sprinklers will come into operation at any one time. This assumption is warranted in view of statistics which show that out of 3,645 fires of record in sprinklered risks, but 5 sprinklers or less were operated in 66.8 per cent of the whole number of fires; 8 sprinklers or less in 76.1 per cent; 20 sprinklers or less in 88 per cent; 50 sprinklers or less in 93.3 per cent. These statistics also show that automatic sprinklers have been introduced in nearly all classes of manufacturing and mercantile buildings, and also in numerous other places, such as hotels, theatres, schools, cold storage depots, etc. Also, that sprinklers have failed to control but 6 per cent of the fires of record, and that these failures summarize according to cause of failure as follows:

	Per cent
Defective or partial equipment	27
Failure due to water being shut off	24

	Per cent.
Faulty building construction and obstruction	13
Hazard too severe for control	12
Exposures or conflagration	9
Inadequate water supply	7
Water supplies crippled by explosion	2
No watchman	2
Town water out of service	1
Unaccounted for	3

The release principle responsible for the operation of all of the existing approved sprinklers and also a majority of the successful thermostats is that of the fusible alloy, discovered by Sir Isaac Newton in 1799. The sprinkler solder of to-day for ordinary temperatures is marked 160° F., this being the temperature at which the solder granulates or loses its strength. It is composed of: Bismuth, 50 per cent; cadmium, 13 per cent; tin, 12 per cent; lead, 25 per cent. It requires care in making and particularly so in its application to the adjoining metal parts of the sprinkler head. Solders of higher fusing points are made for locations which so require. Sprinklers in use over 20 years under ordinary conditions as to freedom from corrosive influences show on test no change in the fusing point. The stability of the sprinkler solder in this respect is of the utmost value. Once the solder has fused by the heat from a fire, that which holds the sprinkler valve to its seat is removed and the valve opens, either from the spring of the metal parts themselves, or under pressure of water in the pipes. Water then discharges through the sprinkler orifice and is deflected by a splash-plate and distributed in drops over the ceiling and on the floor within the prescribed limitations allotted to one sprinkler. The heads are placed near together on the pipe, generally from 8 to 10 feet apart, and as a rule, covering a floor area of about 80 square feet, the distance varying according to the construction and occupancy of the building and the water supplies, all as precisely stipulated in the requirements. Usually supplies for sprinklers are obtained from the public water service, provided quantity and pressure are ample. Other supplies are elevated gravity tanks, steam and rotary fire pumps, and pressure tanks, the latter consisting of a riveted iron shell resembling that of a boiler, which is filled two thirds with water, and in the remainder an air pressure is created of 75 pounds or more; the discharge pipe to the sprinklers takes out at bottom of tank and the expansion of the air under pressure is sufficient to force all the water out of the tank, the last being discharged under pressure of 15 pounds or more. For best results, it is important that the primary supply to sprinklers be of heavy pressure, 25 pounds or more on highest line of sprinklers, and of sufficient volume to be capable of maintaining approximately this pressure for an ample period with a considerable number of the sprinklers in operation. At least one of the supplies must be automatic on the sprinklers at all times. In addition to the above noted double water supply, a hose inlet pipe is attached to sprinkler systems for connection from hose or steamer of the public fire department, thus allowing the department to make use of the sprinkler piping and heads, the most effective medium through which water can be discharged. Gate valves of prescribed pattern are so located as to control the water supply that it may be shut off for repairs if found necessary. An important adjunct to such a system is a valve which when inserted in the main piping gives an alarm, either electrical or mechanical, in event of a flow of water in the piping. This acts not only to give an alarm of fire, but to notify those interested of any leakage. In places where water within the sprinkler piping would freeze during cold weather, a special «dry valve» is provided which holds the water out of the exposed interior sprinkler piping. By the means of a small pump, air pressure is created within the sprinkler piping which holds the dry valve closed, but is released in event of a sprinkler opening, thus allowing the water to flow in through the dry valve and out through the opened sprinkler. See FIRE UNDERWRITERS.

EVERETT U. CROSBY,
Secretary National Fire Protection Association.

Fire-ships are generally old vessels filled with combustibles, fitted with grappling-irons, to hook enemies' ships, and set them on fire. If they are used on a river they are allowed to be carried down by the current, if they are used at sea advantage is taken of a favorable wind to bear them into the midst of the enemy and set their ships on fire. In ancient times the Tyrians employed them against Alexander, and the Carthaginians against the Romans; and during the Christian era the Crusaders made use of them at Ptolemais (Acre). In the time of Philip II. the Spaniards suffered severely by them on two well-known occasions. The first was at the siege of Antwerp in 1585, when by means of fire-ships Gianibelli utterly destroyed a bridge that the Duke of Parma was attempting to throw over the Scheldt, with the aid of some other vessels which he had prepared so as to explode when they reached the bridge. The second case was when Lord Howard of Effingham used them with such effect against the Armada in 1588. In this case also their use is said to have been suggested by Gianibelli. The Greeks in their struggle with Turkey also employed them with great success. In 1857, during the war with the Chinese, whole fleets of such vessels were sent against the British warships, without inflicting the slightest damage.

Fire-toad, or **Fire-bellied Frog**, one of the commoner and more aquatic of the European toads or frogs (*Bombinator igneus*), so called because of the flame-colored patetus upon the bluish-black abdomen. They have many peculiar and interesting habits, and make good use of the colors. «When these toads,» says Gadow, «are surprised on land, or roughly touched, they curl themselves into an extraordinary attitude displaying the red of their bellies and throats, and remain so until the danger is past, expecting that the enemy will let them alone after having been shown with what a terrible creature it had to deal.» In fact the secretions of the skin are very poisonous, and not even turtles will eat them knowingly. This toad inhabits north-central Europe, and two other species of the genus are known, one in China. It is called «unke» in Germany. Detailed accounts of the animal may be found in Gadow's 'Amphibia and Reptiles' (1901).

Fire Worshippers, the Zoroastrians, called also Guebres. Herodotus, about 450 B.C., said «The Persians think fire to be a god.» Strabo, about 50 A.D., said, «They peculiarly sacrifice to fire and water, placing dry wood on the fire stripped of its bark, with fat thrown on it.» Rev. Dr. Wilson, of Bombay, alleges that «they actually address it in supplication, as if it were sentient, intelligent, divine, and omnipresent, and ready to hear, bless, assist, and deliver; as is clearly proved by many passages of the Vandidad and by several of the Yasts and Has of the Yacna and Niashes, to be found in the works esteemed sacred and used by the Parsis (Parsees) in their daily prayers.» No prominent race now in India has become more rapidly modified by intercourse with Europeans. See GUEBERS.

Fireproofing and Fireproof Construction. The supply of incombustible materials for construction purposes, rather than the rendering of combustible materials fireproof and incombustible by treatment with various chemical substances, has been an important factor in the development of modern building methods.

The subject of fireproofing embraces the manifold plans that have been adopted to erect buildings and repositories for valuable articles capable of resisting the action of fire, and to render wood and textile fabrics incombustible. Among the principal incombustible or fire-retardent materials are asbestos (q. v.), silicate and tungstate of soda, phosphate of ammonia, and borax. A solution of silicate of soda has been found one of the best of the various chemical substances which have been used with the view of rendering wood fireproof. Wood carefully painted and impregnated with this solution requires long exposure to a fierce flame before it becomes charred.

Injections of phosphate of ammonia have been used for fireproof wood in ships with the same fire-retardent effect, but it has been found impossible to render wood absolutely incombustible. After being chemically treated, much greater heat is necessary to kindle it, and its nature is so altered that it burns more slowly, but dampness destroys the effect of the solution, and a beautiful piece of woodwork is in most cases ruined by being saturated with a chemical injurious to its fiber, to the nails and screws holding it together, and to the varnishes upon which depend the beauty of the finished job, and, wherever possible, its use is discontinued.

Among flexible fibrous substances capable of being spun and woven into tissues, asbestos pre-eminently possesses the property of slowly conducting heat, and is largely used for theatre curtains, the padding of fireproof safes, etc. Wool, cotton, and other fibrous matters in common use for the purposes of clothing may be rendered very imperfect conductors by immersion in certain saline solutions, of which sulphate of ammonia and tungstate of soda are most commonly used. The former is cheap, but has the disadvantage of becoming decomposed when the article so treated is ironed. Borax also is very well adapted for rendering articles of dress fireproof, but it weakens the tissue of the material and renders it more liable to tear.

In modern times, a great deal of ingenuity has been applied to the construction of fireproof safes. These are now generally constructed with double walls of stout iron, having a space of three to four inches thick between the walls, filled with some substance which is a bad conductor of heat. See SAFE INDUSTRY IN AMERICA.

In building, the attention of the allied professions of architect and builder has long been devoted to providing materials that will not burn at all. Among early literature on the subject is a small work written in French by Monsieur le Compte d'Espie, Knight of the Military Order of St. Lewis, translated into English by L. Dutens, and published in London 1775, entitled «The Manner of Securing all sorts of Buildings from Fire, or A Treatise upon the Construction of Arches made with Bricks and Plaister, called Flat-Arches, and of a Roof without Timber, called a Bricked-Roof.» The author writes: «The Invention is this; to erect a roof of such Construction (which three years ago I myself built on my House at Thoulouse) as to be absolutely composed of no other materials than Bricks, Mortar, and Plaister, there being no Wood or Iron in the whole Formation of it; and therefore I give it the Name of a *Bricked Roof*. . . . . It is much to be wished that they were universally introduced throughout the Kingdom, what a number of Lives as well as Houses would be preserved from Fire? Accidents that are now so frequent and so numerous would in a great measure be avoided, and besides this great Security, there are other advantages peculiar to these solid flat arches and ought to be well-weighed: for instance they make Apartments in Winter warm and in Summer cool, Rats and Mice can find no shelter there, neither is Noise anyways communicated from an upper to a lower Floor, which as the former now is, is very troublesome, notwithstanding the Care taken to fill up Vacancies and make our floors double, a Method very expensive and what is more takes up a great deal of Room; neither does it absolutely prevent the inconvenience, for an hollow disagreeable Sound is always perceptible, and besides the inclosed Timber of the Floor (as it lies out of Sight) in time grows rotten, no Repair therefore can be done, at last it falls and the whole must be rebuilt.»

Another work also published in London in 1775 had for its title page «Various Methods to prevent Fires in Houses and Shipping, and for preserving the Lives of People at Fires with an Account of Remarkable Accidents by Fire, in different Parts of the World, selected historically, for the space of One Hundred and Eight Years, to this present Period: wherein The Negligence of Architects and Builders, in constructing Buildings in Town and Country is pointed out; and showing That the Encouragement of Arts and Sciences is a public Benefit to these Commercial Islands. With Abstracts from the last Act of Parliament, to regulate Buildings, and prevent Fires in London. Necessary to be known in all Families from the lowest Peasant to the highest Peer in the Realm. Approved by the Society of Arts, Manufactures and Commerce.»

Compte d'Espie had taken his idea from the barrel vaults of the Romans, but his suggested elimination of iron in building has a comparative value in the light of subsequent experiments in fireproof construction in the United States from 1854 to 1870. During this period the substitution of iron for wood for all constructive purposes was thought an advance in the right direction, until it was discovered that iron of all kinds was unreliable if exposed to temperatures of 900° Fahr. and over. The danger to so-called fireproof buildings, in which only this incumbustible material had been extensively introduced, was much greater than to those which had been previously erected without any regard to protection from the effects of fire, in many instances, with structures in which cast-iron fronts had been exclusively used, the effect being a complete collapse. These failures helped to call attention to the danger of using *unprotected iron* for all purposes, and after 1870 the plan diminished in favor, there being an almost universal demand for the abandonment of constructive iron and a return to wood. Thoughtful investigators, however, had directed their attention to the necessity for protecting rather than discarding the use of iron for constructive purposes, and the advantages of *protected iron construction* began to be recognized. As soon as fire protection in connection with constructive steel became an accomplished fact, the improvement of both of these arts advanced rapidly, and the development of the capacity of steel for building purposes became no less remarkable than that of the fireproofing systems used in connection with the metal. The steel skeleton construction now in general use is the principal result, and newly introduced materials and processes are everywhere employed throughout the United States for all improved building purposes, their use also being extended to foreign countries.

The first valuable improvements in fireproofing cast-iron columns were made from 1875 to 1879 by Peter B. Wight, architect, who used porous terracotta in hand-made blocks. Soon after this, rolled iron I-beam girders were fireproofed with porous terracotta in many buildings. The first iron roof trusses of which the individual parts were covered with porous terracotta about 1878 are in the Board of Trade Building at Milwaukee. These were the beginnings of the protection of structural iron. Improvements in floor construction with a view to relieving the floors of weight were made before this time. The first use of hollow burned tiles for this purpose in the United States was made by the late George H. Johnson of Chicago. They were built in one of the corridors of the New York post office in 1873. About the same time Mr. Johnson — whose son, E. V. Johnson, was one of the founders of the Pioneer Fireproof Construction Company — used a similar floor construction in the Kendall building at Chicago, the Singer building at St. Louis, and several others. The contract for the fireproof work of the Chicago City Hall, awarded in 1879, was one of the first in which the fireproof protection of the columns and girders was combined with a floor construction of I-beams and flat hollow-tile arches. Almost all the improvements in the manufacture and use for fireproofing purposes of burned fireclay, between 1879 and 1885, were made by the experts of the Pioneer Fireproof Construction Company and the Wight Fireproofing Company. The Montauk, built in 1881-82, was the first high building erected exclusively for office purposes in Chicago, and is just within the limit of 130 feet now fixed by law, beyond which a building shall not go in Chicago. In it were combined all the plans and materials for fireproof construction then in greatest favor, and since the erection of that building all the improvements in the construction and fireproofing of high buildings have been made step by step. In 1884 the Mutual Life Building on Nassau street, New York City, was fireproofed throughout with porous terracotta and hollow fire-clays. This was the first building in which the under sides of the beams were ever covered by fire-clay tiles for the protection of the same from fire, and leaving a flush ceiling.

The different materials now used in fireproof construction are few in number, and the peculiar application or use in certain places sometimes makes one more desirable than another. The following constitute the principal incombustible materials now in use, singly or in combination; dense and porous clay or terracotta; solid concrete as a lintel in floor construction; cinder concrete supported by light iron work; plaster block of plaster-of-paris and fire-clays as foundation material; expanded metal or wire lath supported on light iron work, leaving an air space. The different uses to which fireproofing material is put in a building are: for floors,— the filling in of the spans between iron beams; for partitions,— the 2-inch to 6-inch walls dividing the interior of a building into rooms; for furring — or covering the inside of exterior exposed walls, leaving an air space; for column covering — all interior columns, and those left exposed by brick work; for girder covering — all girders projecting below the floor arches; for ceilings — the placing of false or hanging ceilings; and for roofs — the flat or sloping base for slate, etc.

The standard regulations for fireproof buildings suggested bv the National Board of Fire Underwriters, and incorporated in the building laws, provide that every building hereafter erected or altered to be used as a theatre, lodging house, school, jail, public station, hospital, asylum, institution for the use, care or treatment of persons, the height of which exceeds three stories, and not more than 40 feet in height, and every building hereafter erected or altered to be used as a hotel, which exceeds four stories, and not more than 50 feet in height, excepting all buildings for which specifications and plans have been heretofore approved by the proper authorities, and every other building, the height of which exceeds 55 feet or more than four stories in height, shall be built fireproof, that is to say — they shall be constructed with walls of brick, stone, Portland cement, concrete, iron or steel, in which wood beams or lintels shall not be placed, and in which the floors and roofs shall be constructed with rolled wrought iron or steel floor beams, so arranged as to spacing and length of beams that the load to be supported by them, together with the weights of the materials used in the construction of the said floors, shall not cause a greater deflection of the said beams than one-thirtieth of an inch per foot of span under the total load, and they shall be tied together at intervals of not more than eight times the depth of the beam with suitable tie-rods.

Between the floor beams shall be placed brick arches springing from the lower flanges of the steel beams, or the spaces between the beams may be filled with hollow tile arches of hard-burnt clay or porous terracotta, or arches of Portland cement reinforced with metal, or such other fireproof composition may be used, provided that in each and all cases the strength and method of construction shall be acceptable to the Inspector of Buildings. The stairs and staircase landings shall be entirely of brick, stone, Portland cement, concrete, iron or steel.

No woodwork or other inflammable material shall be used in any of the partitions, furrings or ceilings in any such fireproof buildings, excepting, however, that when the height of the building does not exceed eight stories, nor more than 100 feet, the doors and windows, and their frames and trims, the casings, the interior finish when filled solidly at the back with fireproofing material, and the floor boards and sleepers directly thereunder, may be of wood, but the space between the sleepers shall be solidly filled with fireproofing materials and extend up to the floor boards. When the height of a fire proof building exceeds eight stories or more than 100 feet, the floor surfaces shall be of stone, cement, rock asphalt, tiling or similar incombustible material, or the sleepers and floor boards may be of wood treated by some process approved by the Inspector of Buildings to render the same fire-retarding. All hall partitions or permanent partitions between rooms in fireproof buildings shall be built of fireproof material, and shall not be started on wood sills, nor on wood boards, but be built upon the fireproof construction of the floor and extend to the fire proof beam filling above. The tops of all doors and window openings in such partitions shall be 12 inches below. The provisions for inclosing structural iron and steel work, for elevator inclosures, stairs, openings in floors and roofs for light, ducts for pipes and ventilation, fireproof shutters and doors, the installation of electrical work and fire appliances are also outlined on a careful and elaborate scale, with which, however, great simplicity and perfection of construction are combined.

It has been pointed out that modern so-called fireproof appliances tend toward a protection of property rather than a protection for life, and the delusion of the «absolutely fireproof» building has provided a fertile theme for discussion, but it undoubtedly stands to reason that with the advances made in the fireproof construction of buildings, the danger to life has been, if not proportionately, at least considerably diminished.

The unsatisfactory nature of so-called «fireproof wood» has already been pointed out, and a movement for relief from compulsion in its use has long been agitated by architects and builders. Described as «an obnoxious imposition,» a repeal of the fireproof wood clause in the Building Code is sought, and is now supported by the National Board of Underwriters. The influence of this clause has been much more detrimental than would appear to the casual observer. The permanence of any process or measure adopted for use in the great building industry, which architects, owners, and builders are all constantly studying to improve depends on merit alone. As such merit is established, no laws are required to secure prompt adoption.

Fireproofed wood is not a material of standard and recognized merit like hollow brick or wire glass. It is a material which has been for the most part manufactured in order to enable builders to meet the provisions of the law, and builders themselves have no confidence in the value of such fireproofing. Experts are agreed that the amount of wood used in the finish of buildings, the walls, floors, and windows of which are thoroughly fireproofed, is not a source of danger, and in building a skyscraper there is no ordinary business inducement to have the roof fireproofed. Ex-Fire Chief Croker of New York says «the only way to make a building fireproof is to build it of non-inflammable materials from the foundation up to the skylight, and permit only fireproof furniture to go in. And the less oil and paint used in a building which is desired to be fireproof, the better.»

Among the leading systems of fireproof construction are the Roebling system, described as «a system of fireproof construction that is fireproof;» the Rapp system of fireproof construction; the Hennebique iron-concrete system of construction; the De Mann system of fireproof construction, the systems employed by leading building companies.

Of the many high buildings of steel skeleton construction erected in the large cities of the United States by the G. A. Fuller Company, in which the various problems of fireproofing were elaborately carried out, several passed through such disastrous ordeals as the Baltimore fire in 1904, and the earthquake and fire of San Francisco in 1906. In no case was there any but trifling damage done to their structural portion. They were all repaired by renewing the woodwork and decorative portions of the buildings and the damaged part of the exteriors. The percentage of salvage in these buildings ranged from 60 to 85 per cent. PAUL STARRETT,

President, Fuller Construction Company.

Fire, Property Losses. The following table gives the property and insurance losses in the United States from 1880 to 1911:

YEARS.	Property loss.	Insurance loss.
1880	$74,643,400	$42,525,000
1881	81,280,900	44,641,900
1882	84,505,024	48,875,131
1883	100,149,228	54,808,664
1884	110,008,611	60,679,818
1885	102,818,796	57,430,789
1886	104,924,750	60,506,567
1887	120,283,055	69,659,508
1888	110,885,665	63,965,724
1889	123,046,833	73,679,465
1890	108,993,792	65,015,465
1891	143,764,967	90,576,918
1892	151,516,098	93,511,936
1893	167,544,370	105,994,577
1894	140,006,484	89,574,699
1895	142,110,233	84,689,030
1896	118,737,420	73,903,800
1897	116,354,570	66,722,140
1898	130,593,905	73,796,080
1899	153,597,83	92,683,715
1900	160,929,805	95,403,650
1901	174,160,680	106,680,590
1902	161,488,355	94,775,045
1903	145,302,155	104,532,000
1904	222,198,050	144,621,235
1905	165,221,650	116,446,324
1906	518,611,800	292,124,866
1907	215,084,709	127,847,000
1908	217,885,850	157,842,500
1909	188,705,150	143,536,212
1910	214,003,300	150,246,000
1911	*225,000,000	*160,000,000
Total 33 years	$5,147,253,724	$3,178,271,685

* Estimated.

Firing Machines, blasting batteries, electric blasting machines or exploders are electric generators which are used in firing charges of explosives, in blasting, and in military and naval operations. Broadly speaking, there are three types: (1) in which the current is induced in coils of wire surrounding the poles of a permanent magnet, by suddenly detaching a soft-iron armature therefrom; (2) in which a coil-wound armature is rotated between the poles of a permanent magnet; (3) in which a coil-wound armature is rotated between the poles of an electro-magnet as in an ordinary dynamo. It has been found advantageous in practice to construct the dynamo-electric machines on the series method of winding, that is, the field-magnet coils, armature, and external circuit (which in this case is the firing-line) are joined together in series. These machines are operated by cranks or by means of racks and pinions, many mechanical arrangements having been devised by which to secure the continuously accelerated motion and automatic switch-off which is desired. The general principle upon which the dynamo-electric machines work is that an armature, rotated between the poles of an electromagnet, has set up in its coils a feeble electric current, due to the magnetization produced by the residual magnetism in the iron. By continuing rotation (with the firing-line short-circuited) the weak current thus started passes round the field-magnet coils, increases the intensity of the field, and, consequently, the volume of current in the armature. This gradual increase or building up of the current goes on, until the maximum capacity of the machine is reached. At the limit of magnetic saturation, the short circuit previously existing is automatically broken and the whole available energy is switched on to the firing-line, through the binding posts or terminals on the side or top of the machine, to which the leading wires are attached. Machines are rated in the market at the full number of detonators which a machine of that pattern will fire, but, to ensure freedom from «miss-fires,» a machine should never be worked up to its rated maximum capacity. The diameters of the leading wires should vary with their lengths, thus for distance up to 600 feet No. 16 B. W. G. (0.065 inch) wire should be used, for 800 feet No. 14 (0.083 inch) and for 1,000 feet No. 13 (0.095 inch). To prevent accidental explosions, it should be the invariable rule, that the leading wires are not attached to the binding posts of a firing machine, until all other preparations for firing are completed and everyone has got to a safe distance from the blast or mine; and it should be also the invariable rule that the leading wires are detached from the machine as soon as the blast has been fired.

Firishtah, fē-rēsh'tä, more properly **Mohammed Kasim**, Persian historian: b. Astrabad about 1550; d. about 1612. He went to India, and was for some time the tutor of a native prince. He wrote a 'History of the Mohammedan Power in India till the Year 1612,' which is the best yet written on the period which it embraces.

Firmament, in ancient astronomy, the eighth heaven or sphere, with respect to the seven spheres of the planets which it surrounds. It is supposed to have two motions, a diurnal motion, given to it by the *primum mobile* from east to west, about the poles of the equator; and another opposite motion, from west to east, which last it finishes, according to Tycho, in 25,412 years; according to Ptolemy, in 36,000; and according to Copernicus, in 25,800; in which time the fixed stars return to the same points in which they were at the beginning.

Firman, fėr'man or fėr-män', in Turkey, any decree issued by the Porte and authenticated by the sultan's own cipher or signet. Each of the ministers and members of the divan has right of signing firmans relative to the business of his own department, but only the grand vizier is authorized to place at their head the cipher containing the interlaced letters of the sultan's name, which alone gives them force. A decree signed by the sultan's own hand is called hatti-sherif. The name firman is also applied to a passport issued either by the Porte or a pasha, enjoining the subordinate authorities to grant protection and assistance to the traveler in whose favor it is granted. (See TURKEY.) In India, a written permission to trade is called a firman.

Firozpur, fē-rōz-poor', India, town, Punjab, on the Sutlej River, three and a half miles from Sutlej, capital of a district of the same name. It has the largest arsenal in the Punjab. It has a trade in grain and manufactures of cotton. Pop., including the military cantonments two miles south of the city, 50,437. Firozpur is also the name of a town in Gurgaon district, Punjab. Pop. 6,848.

First Aid, the term applied to a plan for popularizing certain measures for the relief of the injured and distressed. Instant application is necessary in many cases, if remedial measures are to succeed. Thus a slight knowledge of the course of arteries and of means for compressing them will enable one to stay a fatal flow of blood. Antidotes for poison rapidly lose value as time elapses. The resuscitation of the drowning is largely a matter of persistence in artificial respiration. General knowledge of the cleansing of wounds is all-important. This knowledge is now widely used in armies and among people most liable to witness accidents, as trainmen, etc., circulars of instruction and packets containing the most necessary articles for dressing wounds being often furnished by those in authority.

First-born (Heb. *bekor*, Gr. *prōtotokos*, Lat. *primogenitus*), in scriptural use, signifies the first male offspring, whether of man or of other animals, due to the Creator by the Mosaic law as a recognition of his supreme dominion. The first-born male, whether of men or of animals, was devoted from the time of birth to God, and the first-born male child had to be redeemed one month after birth by an offering not exceeding in value five shekels of silver (Exod. xiii. 13), provided the child lived longer than that period. The first-born male of animals also, whether clean or unclean, was equally regarded as devoted to God. By the Mosaic law primogeniture had certain privileges attached to it, the chief of which were the headship of the family and a double portion of the inheritance. Among other nations considerable variety existed as to the succession of children to the inheritance of their parent. See INHERITANCE; PRIMOGENITURE.

First-footing, a Scottish practice still existing in Edinburgh, and elsewhere. Late in the evening of 31 December in each year, 2,000 or 3,000 of the common people assemble in the vicinity of the Edinburgh Tron Church, to ascertain on good evidence when the new year commences. When the clock is about to strike 12 they cheer so loudly that the strokes are not heard. Instantly that it has finished, they depart for the purpose of first-footing; that is, each one tries to be the first person that year to cross the threshold of his friend's house and wish him the compliments of the season. On such occasions also not a few are accustomed to drink their friends' health at the manifest risk of their own.

First-fruits and **Firstlings** are terms of the Mosaic and Jewish law, denoting respectively those portions of the fruits of the earth and of the increase of live stock which were to be offered to the Lord (for First-fruits, see Exod. xxii. 29; Num. xviii. 12, etc.; for Firstlings, see Exod. xiii. 12; Num. xviii. 15, etc.). A custom which had its rise in the Roman Catholic Church as early as the 6th century was that men ordained to ecclesiastical offices made to the bishop who ordained them an offering of some portion of the first year's revenue of the office. In course of time the claim of the See of Rome to the whole of the first year's income of a bishopric or an abbey or other office or benefice was recognized and enforced. When in 1531 King Henry VIII. forbade the payment of this tax to the papal see by his subjects, the amount of the first-fruits annually forwarded from England to Rome was about £3,000. When Henry was made supreme head on earth of the Anglican Church, the tax of the first-fruits was still exacted, but the proceeds were turned into the royal treasury. Such was the disposition made of the first-fruits in England till in 1704 Queen Anne, for herself and successors, relinquished the income from first-fruits and other imposts on the profits of spiritual preferments and, under an act of the Parliament, formed this income into a fund for the relief of clergymen holding poor livings: this is «Queen Anne's Bounty.» The official name of first-fruits is *Annates,* or *Annalia,* from *annus,* year: they are also called *primitiæ,* the Latin equivalent of first-fruits.

Firth, Charles Harding, English historian: b. Sheffield, England, 16 March 1857. He was educated at Clifton and Oxford and since 1883 has devoted his attention to literary work and teaching at Oxford, having been lecturer at Pembroke College there 1887–93. He has published: 'The Clarke Papers' (1891–1901); 'Scotland and the Commonwealth' (1895); 'Scotland and the Protectorate' (1899); 'Oliver Cromwell' (1900); 'Cromwell's Army' (1901); etc.

Firth, Mark, English steel manufacturer: b. Sheffield 1819; d. 28 Nov. 1880. In 1849 with his father and brother he established in Sheffield the great Norfolk steel works, whose specialty soon became the manufacture of steel ordnance. He was a munificent benefactor to his native town, his gifts including almshouses (1869), a public park (1875), and the Firth College (1879) in connection with university extension.

Fis'cal, from *fiscus,* the state treasury. (1) in most German states an officer who has charge of the state treasury. (2) In the German states, and in Scotland, the fiscal is also the public prosecutor in the criminal courts. This use of the name seems to arise from the ancient practice of punishing most violations of the criminal law by a fine.

Fiscal Lands, lands, among the Franks, set apart for the use of the sovereign to support his dignity, and to give him the means of rewarding merit or valor.

Fischart, Johann, yō'hän fish'ärt, German satirist: b. Mainz between 1545 and 1550; d. Forbach about 1590. As a satirist he is the most unrestrained of his age, inexhaustible in droll, humorous, and witty thoughts, not seldom guilty of equivoque and obscenity, intimately acquainted with the follies of his age, and never at a loss whether to ridicule or lash them. He treats the German language with the greatest freedom, coining new words and turns of expression without any regard to analogy, and displaying in his most arbitrary formations, erudition and wit. In the broad comic and burlesque he is not to be surpassed, and even in his most satirical effusions there is an honesty and good nature always observable. His most celebrated works are a rifaccimento of the Gargantua of Rabelais, first printed in 1575; 'Das gluckhaft Schiff von Zürich' (The Lucky Ship of Zurich) (1576); 'Aller Praklik Grossmutter' (1572); 'Eulenspiegel Reimensweiss' (1572), and several others. We find in Fischart the first attempt at German hexameters.

Fischer, Emil, ā'mĕl fish'er, German chemist: b. Euskirchen 1852. He was appointed professor extraordinary at the University of Munich 1852 and became professor of chemistry at Erlangen 1882, filling a similar chair at Würzburg 1885. He was appointed professor of organic chemistry at the University of Berlin 1892, and in 1902 received the Nobel prize for chemical research. He has paid much attention to the chemical constitution of sugars, his principal work being 'Anleitung zur Darstellung organischer Präparate.'

Fischer, Johann Georg, yō'hän gā-ōrg' fish'er, German poet: b. Gross Süssen, Würtemberg, 25 Oct. 1816; d. 1897. His lyric poems are in eight volumes (1854–91). He excelled in popular songs and ballads; and in his love songs nobly idealized nature and passion. He wrote four dramas: 'Saul' (1862); 'Frederick II. of Hohenstaufen' (1863); 'Florian Geyer' (1866); 'Emperor Maximilian of Mexico' (1868). In 'From Bird Life' (1863) he notes the characteristic phenomena of the psychic life of animals with the acuteness of a naturalist and the sympathy of a poet.

Fischer, Kuno, koo'nō, German historian of philosophy: b. Sandewalde, Silesia, 23 July 1824; d. Heidelberg, 4 July 1907. He was interdicted from teaching philosophy at Heidelberg in 1853; but after filling professorships in Berlin and Jena, had the satisfaction of being called to the chair of philosophy at Heidelberg in 1872. His principal writings are: 'Diotima; The Idea of the Beautiful' (1849); 'Logic and Metaphysic, or the Doctrine of Science' (1852); 'History of Modern Philosophy' (1852–93, new ed. in 9 vols. 1897 et seq.), his greatest work, written in the form of brilliant monographs on Descartes, Kant, Fichte, Schelling, and other great philosophers down to Schopenhauer; 'Francis Bacon and His Successors' (1856); 'Lessing's Nathan the Wise' (1864); 'Spinoza's Life and Character' (1865); 'Origin and Evolution-Forms of Wit' (1871); 'Goethe Schriften' (1895–1900).

Fischer, Ludwig Hans, lood'vig hänts, Austrian painter: b. Salzburg 2 March 1848. After a course of art study he traveled extensively, settling finally in Vienna. Among his works are nine landscapes for the Museum of Natural History, Vienna, and etchings and engravings forming historical landscapes from Austria-Hungary. He is the author of 'Die Technik der Aquarellmalerei.'

Fiscus. See Fiscal.

Fish, Hamilton, American diplomatist: b. New York 3 Aug. 1808; d. Garrison, N. Y., 7 Sept. 1893. He was graduated at Columbia College, and admitted to the bar in 1830. A Whig in politics, he was elected a congressman in 1842, and governor in 1848. In 1851 he was returned to the United States Senate, where he opposed the repeal of the Missouri Compromise and joined the Republican party on its formation. He was secretary of state under Grant 1869–77, signing, as one of the commissioners, the Washington Treaty of 1871, and carrying through the settlement of the "Alabama" question.

Fish, Nicholas, American military officer: b. New York 28 Aug. 1758; d. there 20 June 1833. He joined the Continental army, participated in the battles at Saratoga in 1777; led a corps of light infantry in the battle of Monmouth; and otherwise distinguished himself during the Revolutionary War. He was made adjutant-general of New York in 1786; supervisor of United States revenue in 1794, and president of the New York State Cincinnati Society in 1797.

Fish, Nicholas, American diplomatist: b. New York 19 Feb. 1848; d. there 16 Sept. 1902. He was educated at Columbia and the Harvard Law School, practised law in New York, became second secretary of legation in Berlin 1871, secretary in 1874, and in 1877–81 was *charge d'affaires* in Switzerland. From 1882 to 1886 he was United States minister to Belgium, and in 1887 entered the firm of Harriman & Company, bankers of New York. He was a son of Hamilton Fish (q.v.), the well-known secretary of state, and president of the New York chapter of the Society of the Cincinnati.

Fish. In the popular sense a fish is a cold-blooded, chordate or vertebrate animal, adapted for life in the water, breathing by means of gill-slits all its life, having its limbs, if present, developed as fins, never as fingers or toes. This definition excludes invertebrates as having no notochord and no backbone. It excludes the tunicates and enteropneustans as not fish-like in form when adult, and as being at all times without fins. It excludes the amphibians, because these develop, in the adult state, jointed limbs with toes, and most of them cease to breathe with gills or gill-slits. The fishes, as thus defined include all members of the groups known as the lancelets (*Leptocardii*), the lampreys (*Cyclostomi*), the sharks (*Elasmobranchii*), and the true fishes (*Teleostomi*), as also all of the varied series of extinct fish-like form. In technical writings the lancelets and the lampreys are usually excluded from the class *Pisces* or fishes, and many writers would still further limit the name of *Pisces* by the exclusion of sharks and skates, and also the chimæras (*Holocephali*). Still others exclude the *Dipneusta*, and the extinct *Placodermi* or *Ostracophori*, and *Arthrodira*. It is perhaps not necessary to regard *Pisces* or fishes as a technical term at all. In this case there is no violence in using the word fish as coextensive with the popular definition as given above. Taking this significance, we may recognize two classes of chordates (*Tunicata* and *Enteropneusta*) as lying below and to one side of the series of fishes, while this series is itself composed of nine classes or sub-classes unequal in size and in taxonomic value, *Leptocardii*, *Cyclostomi*, *Cycliæ*, *Elasmobranchii*, *Ostracophori*, *Arthrodira*, *Crossopterygii*, *Dipneusta*, and *Actinopteri*. The first two groups differ widely from the others, and must in any scheme of classification be regarded as forming distinct classes. The last-named class or sub-class includes the great majority of recent fishes. The *Cycliæ*, *Ostracophori*, and *Arthrodira* are wholly extinct; the *Crossopterygii* and *Dipneusta* nearly so.

Taking the true fishes, or *Actinopteri*, as typical of the group, we see at once that these have the general structure of the higher vertebrates, but with less complexity of structure, with various adaptations that fit these animals for life in the water.

Form of the Body.— The body is in general boat-shaped, the head in the same axis, without neck in most cases, the shoulder-girdle being attached to the skull at the nape, and in the more specialized forms the pelvic girdle joined to the shoulder-girdle below. In this case the vertebral column might be held to consist of skull and tail only. The form is fitted for swift progress through the water. The body is longer than deep, and the greatest width is in front of the middle, leaving in most cases the compressed paddle-like tail to serve as the organ of locomotion. To all of these statements there are numerous exceptions. Most fishes depend on speed to secure their food or to escape from their enemies, but there are some which preserve themselves by lying prone on the bottom, by hiding in crevices of one sort or another, or which are defended from all attacks by pungent spines or by a bony coat of mail.

Exoskeleton of the Fish.— The surface of the fish is typically covered by an exoskeleton of overlapping scales. To this there are many exceptions. Some are naked, some covered with prickles, spines, or bony plates. The scales may be ganoid (enameled, like teeth), placoid (reduced to shagreen-like roughness), ctenoid (with a comb-edge), or cycloid (smooth, with concentric striæ), or they may be variously coalescent, forming bony plates. Historically the placoid scale precedes the ganoid scale. This is followed by the cycloid, and finally by the ctenoid type. Bony plates may be formed by the coalescence of scales of any type.

Fins of the Fish.— In most cases the motion of a fish is mainly produced by the lateral movement of the caudal or tail fin, the other fins exerting chiefly the function of direction. In the more primitive of existing fishes the different fins are composed of soft rays connected by membrane. The soft rays are finely jointed and usually branched, as distinguished from the spines, which are without branches or joints, and which are usually stiff and pungent. In the more specialized fishes spines are usually present, these occupying the front of the dorsal and anal fins, the first ray of the ventral fin being also spinous.

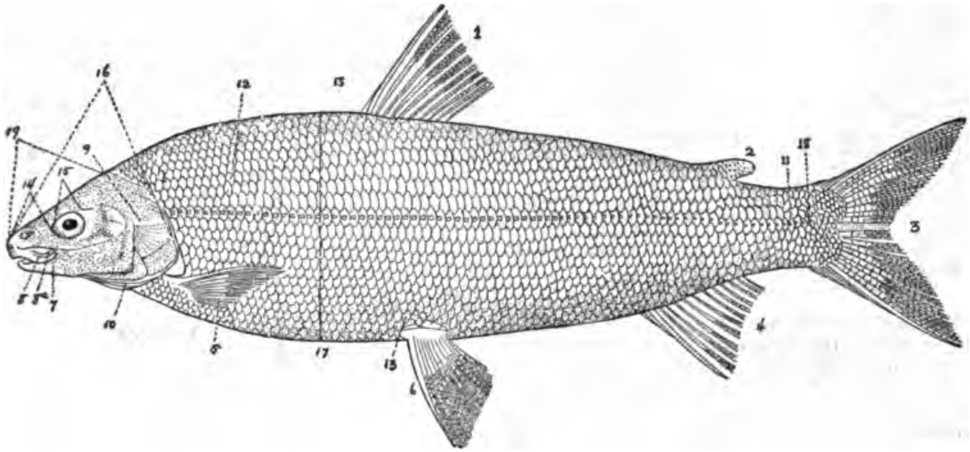
The fins usually present are of two kinds — the paired fins and the vertical fins. The paired fins are represented on either side of the body, the anterior or uppermost pair, the pectoral fins, representing in the fish the arms or forelegs of the higher vertebrates, the lower or posterior pair (ventral or pelvic fins) representing the hinder legs. The vertical fins are on the median line of the body, the dorsal on the back, the caudal on the tail, and the anal on the lower side behind the body cavity. Each of these fins is subject to great variation.

The vertical fins, with their appendages, arise from the modification and specialization of a dorsal median fold of skin. This is found in embryos and in the lancelet and other forms of low organization. It is generally believed that the paired fins, with the bones which support them, have been derived from a lateral fold of skin, similarly modified, and still more specialized. As to this, the evidence is much less complete than in the case of the vertical fins.

At the base of each ray or group of rays in the vertical fins, supporting bones are developed. These bones, called interspinal bones, stand in some definite relation to the bones of the vertebral column, to which, however, they are not directly joined.

The pectoral fin is attached, by means of certain intermediate bones, to the shoulder-girdle. The ventral fin is similarly joined to a pelvis. The pelvis in all the lower fishes is detached from the rest of the skeleton and placed beneath the body cavity. In the more specialized modern forms the pelvis is moved forward, usually connected with the shoulder-girdle, but sometimes attached at the throat well in front of the latter. In accordance with the insertion of the pelvis, the ventral fins are said to be *abdominal* (free from the shoulder-girdle), *thoracic* (connected with the shoulder-girdle), or *jugular* (in front of the shoulder-girdle).

Muscular System of the Fish.— The movement of the fins is accomplished through the agency of muscles. These organs lie band-like along the sides of the body, forming the flesh of the fish. They are little specialized, and not as clearly differentiated as in the higher vertebrates. In the typical fishes there are several distinct systems of muscles, controlling the jaws, the gills, the eyes, and the different fins. The largest of these is the great lateral muscle, composed of flake-like segments, these corresponding in general in number to the numbers of vertebræ. In general, the muscles are white in color and tender in substance. In a few fishes muscular tissues are modified into electric organs.



Great Lake Whitefish (*Coregonus clupeiformis*).
Showing the location of fins and mouth parts (after Jordan and Evermann).

1. **Dorsal fin.**
2. **Adipose dorsal.**
3. **Caudal fin.**
4. **Anal fin.**
5. **Peotoral fin.**
6. **Ventral fin.**
7. **Lower jaw or mandible.**
8. **Upper jaw or maxillary.**

8a. **Supplementary maxillary.**
9. **Opercle.**
10. **Branchiostegals.**
11. **Caudal peduncle.**
12. **Lateral line.**
13. **Series of crosswise scales usually counted.**
14. **Snout.**

15. **Eye.**
16. **Head.**
17. **Depth of body.**
18. **Base of caudal.**
19. **Distance from snout to nape or occiput.**

The skeleton of the fish is cartilaginous in the more primitive forms, bony in the more specialized types. In all cases the bones contain less of mineral matter than do the bones of the higher vertebrates.

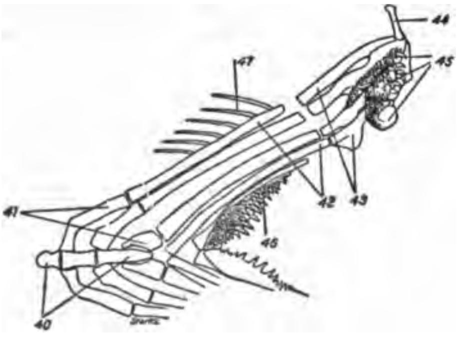
Skeleton of the Fish.— In the process of development the vertebral column is built up on a soft, cartilaginous cord extending lengthwise of the body, called the notochord. This exists in all young fishes, and is more or less completely persistent through life in the more primitive types, as the lamprey or the sturgeon. This notochord is not the backbone, but it indicates where the backbone is to be. In the higher forms the vertebræ are developed around it, strung spool-fashion, as it were, until finally in most recent fishes the original chord is entirely obliterated.

Explanation of plate of the skeleton of the striped bass (*Roccus lineatus*) after Edwin Chapin Starks.

1. Vomer.
2. Ethmoid.
3. Prefrontal.
4. Frontal.
5. Sphenotic.
6. **Parietal.**
7. **Epiotic.**
8. **Supraoccipital.**
9. **Pterotic.**
10. **Opisthotic.**

11. Exoccipital.
12. Basioccipital.
13. Parasphenoid.
14. Basisphenoid.
15. Prootic.
16. Alisphenoid.
17. Hyomandibular.
18. Symplectic.
19. Quadrate.
20. Pterygoid.
21. Palatine.
22. Mesopterygoid.
23. Metapterygoid.
24. Preopercle.
25. Opercle.
26. Subopercle.
27. Interopercle.
28. Articular.
29. Angular.
30. Dentary.
31. Maxillary.
32. Premaxillary.
33. Interhyal.
34. Epihyal.
35. Ceratohyal.
36. Basihyal.
37. Glossohyal.
38. Urohyal.
39. Branchiostegal.
40. Basibranchials.
41. Hypobranchials.
42. Ceratobranchials.
43. Epibranchials.
44. Suspensory pharyngeal.
45. Upper or Superior pharyngeals.
46. Lower or Inferior pharyngeals.
47. Gill-rakers.
48. Supraorbital.
49. Preorbital.
50. Suborbitals.
51. Nasal.
52. Supra-temporal.
53. Post-temporal.
54. Supraclavicle.
55. Clavicle.
56. Postclavicle.
57. Hypercoracoid.
58. Hypocoracoid.
59. Mesocoracoid.
60. Actnosts.
61. Pectoral Rays.
62. Pelvic Girdle.
63. Ventral Spine.
64. Abdominal vertebræ.
65. Caudal vertebræ.
66. Centrum.
67. Neuropophyses.
68. Neural spine.
69. Hæmapophyses.
70. Hæmal spine.
71. Zygapophyses.
72. Parapophyses.
73. Rib.
74. Epipleural spines or Epipleurals.
75. Interneural spines or Interneurals.
76. Dorsal rays and spines.
77. Interhæmal spines or Interhæmals.
78. Anal rays and spines.
79. Hypural.
80. Caudal rays.

The skull of the fish consists of a great variety of bones, the names of which are given on the accompanying plate. In the naming of the bones of the head and shoulder-girdle of fishes great confusion has arisen. This is due mainly to ineffective attempts to trace the homologies of these bones with bones occupying similar positions in the skeleton of man; while, no doubt, the skeleton of the higher vertebrates is derived by descent from that of primitive fishes, homologies can be traced only in a general way. The skull of the one corresponds to the skull of the other, but the specialized fishes have developed many more bones than were found in ancestral types, and many more than exist in man. In like fashion the shoulder-girdle in the one represents that of the other, but the fish has more bones than can be covered by the names scapula, coracoid, and clavicle.

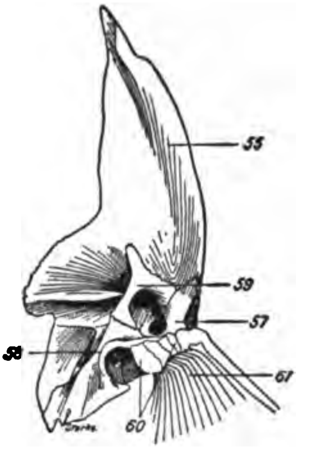


STRIPED BASS (*Roccus lineatus*). Branchial arches (after Starks).

40. Basibranchials.
41. Hypobranchials.
42. Ceratobranchials.
43. Epibranchials.
44. Suspensory pharyngeal.
45. Upper pharyngeal.

In the accompanying plate of the bones of the striped bass (after Edwin Chapin Starks) we use the terminology now adopted by Gill, Starks, and most American osteologists. The bones of the head may be roughly divided into those of the cranium, the jaws, the suspensory (of the lower jaw), the gill-structures, and the membrane-bones. The latter, on the outside of the head, are formed by ossification of the skin, and have no homologies among the higher vertebrates. They are also wanting in the sharks and lampreys.

The shoulder-girdle in the lower forms consists of an arch of cartilage. In the progress of specialization this is divided into several pieces as indicated in the plate. It is separate from the skulls in sharks and skates, as in the higher vertebrates. In the typical fishes its uppermost bone (post-temporal) is joined to the temporal bone of the cranium. In some groups it is immovably consolidated with the latter. In the eels, by a process of degeneration, it loses its connection with the skull. The pelvis in fishes usually consists of a single bone on either side, more or less fully coalesced with its fellow.



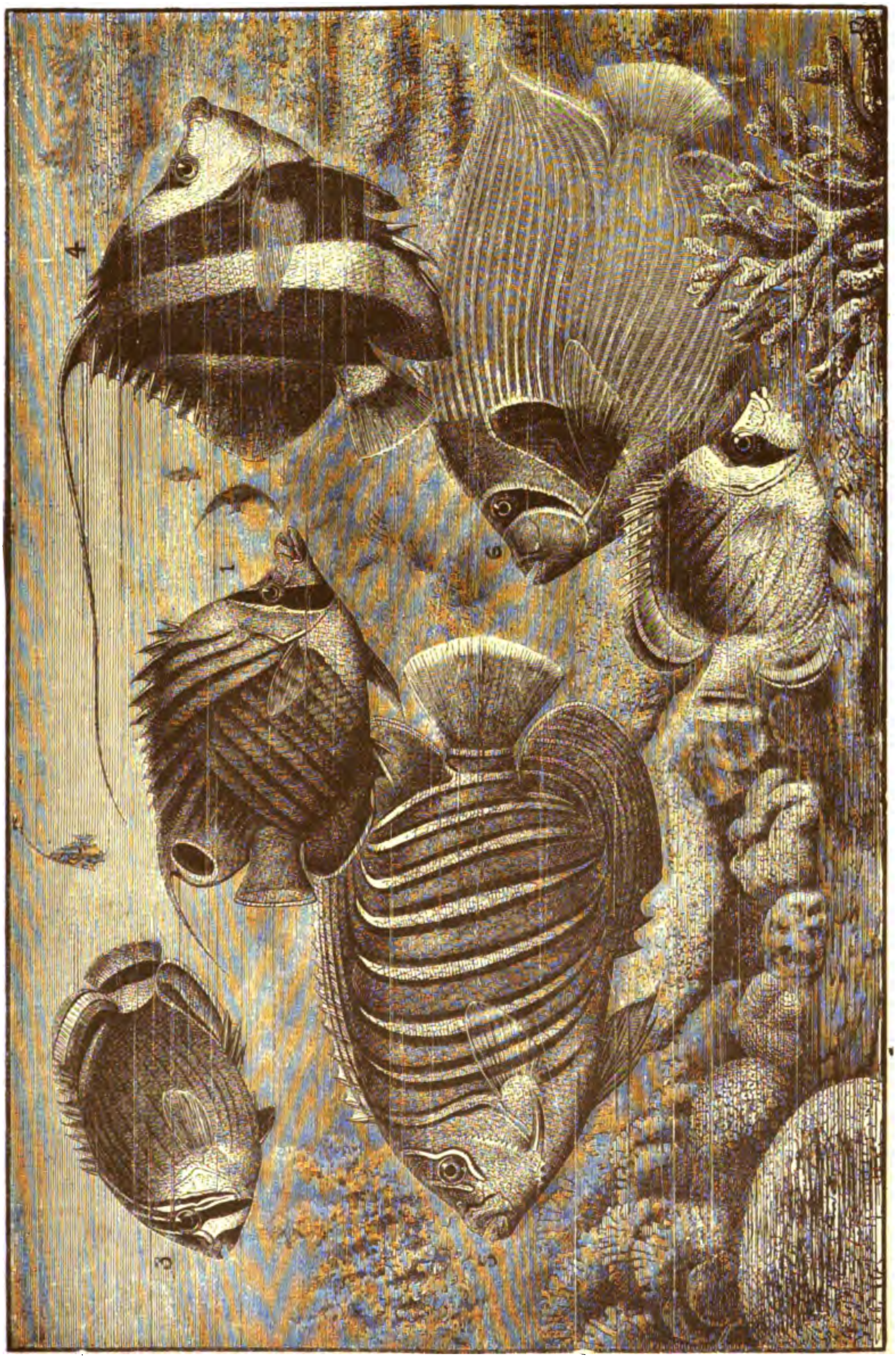
BUFFALO-FISH (*Ictiobus bubalus*). Inner view of shoulder-girdle, showing mesocoracoid arch.

55. Clavicle.
57. Hypercoracoid.
58. Hypocoracoid.
59. Mesocoracoid.
60. Actinosts.
61. Pectoral rays.

The vertebral column may be divided into abdominal and caudal vertebræ. The former have their lower processes divergent, to include the body cavity. In the caudal vertebræ, the hæmal processes unite, leaving opening only for the hæmal canal or place of the large artery. The neural processes of each vertebræ unite above the centrum or body of the vertebra, leaving space for the spinal cord. The pointed upper continuation of each is called the neural spine, as the downward projection is called the hæmal spine. In the primitive fishes generally the tail is extended to a point, the last vertebra being progressively reduced, and the caudal fin lying below the axis. This forms the heterocercal tail, characteristic of the shark, sturgeon, and of various extinct types of fish. In the modern types, the vertebræ cease more or less abruptly at the base of the caudal fin, the tail being homocercal.

The number of vertebræ is least in the more specialized, spiny-rayed fishes. In several fam-

SPINY-FINNED FISHES (Chætodontidæ).



1. The Banner Fish (Chætodon setifer).
2. The Coral Fish (Chætodon fasciatus).
3. The Clipp Fish (Chætodon vittatus).
4. The Lash Fish (Heniochus macrolepidotus).
5. The Prince Fish (Chætodon diacanthus dux).
6. The Emperor Fish (Chætodon imperator).

ilies of these there are 24 vertebræ, 10 abdominal and 14 caudal. This number is much greater in all the soft-rayed and all the primitive forms. It is also materially increased by a process of degeneration in most arctic or subarctic derivatives from these families, and in general in fresh-water, pelagic, and deep-sea forms derived from forms having 24 vertebræ. In cold waters, fresh waters, and the oceanic abysses, the processes of competition called natural selection are apparently less active, and we have the phenomenon of reduction of parts with the increase in number of similar structures.

The cause for the vegetative increase in the numbers of vertebræ as we leave the tropical shores may perhaps be found in the reduction of the stress of natural selection. For such «cessation of selection» the name *panmixia* has been suggested by Dr. August Weismann. It should be noticed that the increase in the number of vertebræ is accompanied, necessarily, by the loss of importance and the reduction of specialization in each individual one. In this change the fin-rays usually share, there being a greater number, as a rule, in forms outside the tropics as compared with similar forms on warm shores.

Organs of Nutrition.— The organs of nutrition in the fish are generally homologous with those of higher vertebrates. Some fish feed exclusively on vegetable food. These have generally incisor-like teeth loosely planted in the gums, and a greatly elongate alimentary canal.

Most fishes feed on animal food, other fishes, crustaceans, mollusks, worms, insects, and whatever else may be found in the sea. The mouth and teeth are adapted to the kind of food, and the varieties in form and armature are even more varied than the forms of the body among fishes.

The mouth is usually capacious. It may have no teeth; it may have teeth on the jaws only, or any bone in its circumference may be armed with them. In most fishes additional teeth of one sort or another may be found on the pharyngeals, in the gullet behind the gills.

The stomach may be U-shaped — an opening at either end — or it may have the form of a blind sac, the two openings close together. Often glands, called pyloric cæca, secreting a digestive fluid, occur at the end of the stomach. The intestine may be a single tube, or it may be variously complicated, wound in spiral, or as in the sharks, having its surface increased by means of a spiral valve within. The liver, gall-bladder, and spleen are usually developed in fishes much as in the higher forms.

Fishes lack salivary glands. The tongue is cartilaginous or bony, with few nerves of taste, although taste buds may exist in the barbels, as in the cat-fish. Kidneys lie along the inner edge of the backbone, less specialized than in the higher vertebrates, their ducts leading into a common cloaca. In the lower fish-like forms (lancelets) the structures which serve the purpose of kidneys bear a close resemblance to similar glands (nephridia) in worms.

Organs of Respiration and Circulation.— In the lowest fish-like forms (lancelets), the heart is reduced to a simple pulsating tube. In the typical fishes it consists mainly of three parts, the auricle, the ventricle, and a thickened part of the large artery, known as the *bulbus arteriosus.* These parts correspond in a general way to right auricle and right ventricle in the higher vertebrates. The blood reaches the heart from the vein-system of the body. It is passed from auricle to ventricle, then sent through a large artery to the gills to be purified. From the gills it is distributed through the main artery or aorta to the different parts of the body, to be again gathered up from the capillaries into the veins.

It is not returned to the heart after purification, as in the higher vertebrates. Its flow is therefore relatively sluggish, and, as in reptiles and amphibians, its temperature is little above that of the environment. In some of the more primitive fishes the heart is more complex than in the typical forms, the arterial bulb being provided with a large number of valves.

All the chordate animals, including the tunicates and the *Enteropneusta,* have the purification of the blood effected through some form of gill-slit. In the lower forms these are merely slits, admitting water to the pharynx, where it comes in contact with thin membranes covering capillaries filled with blood.

In the typical fishes a much more elaborate apparatus is developed. There are usually five long bony arches attached to the cranium above and to the base of the tongue below. Each of these has two rows of slender filaments, the gills. The blood flows in and out of these filaments, where it comes in contact with the water. This water is swallowed through the mouth, and is forced out through the gill-opening. Behind the true gill-arches is a fifth arch, more or less similar, usually without gills, being modified to form a pair of gullet-jaws, the pharyngeals. On the anterior edge of the first gill-arch is a series of projections, sometimes forming a straining apparatus. These are the pharyngeals. A small accessory gill, the pseudobranchia, is usually developed on the inner side of the opercle or gill-cover.

In sharks and skates, the gills are fastened by their longer side, like the leaves of a book. In other groups there are many minor modifications.

In the sharks and skates there is no trace of lung or air-bladder. In the more primitive forms ancestral to the true fishes, there is a well-developed lung, which assists in the purification of the blood in exactly the same way as the lung of the higher vertebrates. Most of the forms known or supposed to possess lungs (*Dipneusta, Crossopterygii, Ganoideii*) are now extinct. In the few living forms with this character (*Neoceratodus, Lepidosiren, Protopterus, Polypterus, Lepisosteus,* and *Amia*) this lung is either of one or two lobes. It is connected by a trachea with the pharynx. In the earliest forms this windpipe opens below the œsophagus, as in the higher vertebrates, but in the other forms, the opening is transferred to the dorsal side. These early fishes were therefore literally amphibious, being capable both of breathing atmospheric air with the lungs, and the air dissolved in water, with the gills. There is little doubt that from some of these forms, probably crossopterygians, the whole series of land vertebrates is descended, while from the same stock has arisen the great body of the typical or bony fishes. In the former case we have the gradual obliteration of the gills, which are developed only in embryonic or larval stages. Among the typical fishes we have the gradual degeneration of the lung and the loss of its function as a breathing-organ.

In this case we have first the reduction of the lung to a single sac, the loss of its cellular structure. It assumes in the soft-rayed fishes the form of an empty sac, sometimes divided by a cross-constriction, the anterior part connected with the œsophagus by a very slender membranous tube. This tube is gradually lost in the spiny-rayed fishes, no trace of it usually existing except in the embryo. The airbladder is then a hollow sac, filled with air containing an excess of nitrogen, this air being secreted from the blood of the fish. The air-bladder has some value in enabling the fish to hold itself in place in the water. In pelagic fishes, and in fishes which habitually lie on the bottom, the air-bladder is often greatly reduced, or entirely obliterated, when the fish is fully developed. The different stages of the air-bladder must be looked on as steps toward the gradual loss of the lung, an organ which becomes progressively less important in the more complete adjustment of the fish to continuous life in the water.

The Organs of Sense.— The sense-organs of the fish correspond in general to those of the higher vertebrates. The sense of taste is, however, feeble, and that of hearing is muffled and without much power of acute discrimination. The sense of smell resides in the nostrils, which have no relation to the work of breathing. No fish breathes through its nostrils, and only in a few of the more generalized types does the nostril pierce through the roof of the mouth. In the bony fishes the nostrils are cavities, one on either side, lined with delicate or fringed membrane, well provided with blood-vessels, as with nerves from the olfactory lobe. In most cases each nasal cavity has two external openings, either simple or, with the rim of the nostril, forming a papilla or barbel. The openings may be round, slit-like, pore-like, or may have various other forms. In certain families of bony fishes there is but one opening to each nostril. In the sharks, rays, and chimæras there is also but one opening on either side, and the nostril is larger and highly specialized, with valvular flaps controlled by muscles which enable them «to scent actively as well as to smell passively.»

In the lancelet there is a single median nostril, a small depression at the front of the body covered by ciliated membrane. In the hagfish the single median nostril pierces the roof of the mouth, and is strengthened by cartilaginous rings, like those of the windpipe. In the lamprey the single median nostril leads to a blind sac. In all other fishes there is a nasal sac on either side of the head. There is no doubt that the sense of smell in fishes is relatively acute, and that the odor of their prey attracts them to it. It is known that flesh, blood, or a decaying carcass will attract sharks, and other predatory fish are drawn in a similar manner. At the same time, the strength of this function is yet to be tested by experiments.

The Organs of Sight.— The eyes of fishes differ from those of the higher vertebrates mainly in the spherical form of the crystalline lens. This extreme convexity is necessary because the lens itself is not very much denser than the fluid in which the fishes live. The eyes vary much in size, and somewhat in form and position. They are larger in fishes living at a moderate depth than in shore-fishes or river-fishes. At great depths, as a mile or more, where all light is lost, they become aborted or rudimentary, and may be covered by the skin. Often species with very large eyes, making the most of a little light, or of light from their own luminous spots, will inhabit the same depths with fishes having very small eyes, or eyes useless for seeing, retained as vestigial structures through heredity. Fishes which live in caves become also blind, the structures showing every possible phase of degradation. The details of this gradual loss of eyes, either through reversed selection or hypothetically through inheritance of atrophy produced by disuse, have been given in a number of memoirs on the blind fishes of the caves of Kentucky, Missouri, and Cuba by Dr. Carl H. Eigenmann.

Many of the sharks possess a distinct nictitating membrane or special eyelid, moved by a set of muscles. The iris in most fishes surrounds a round pupil, without much power of contraction. It is frequently brightly colored, red, orange, black, blue, or green.

In the lowest of the fish-like forms, the lancelet, the eye is simply a minute speck coated by black pigment, connected with the spinal cord by a short nerve. In the development of such a pigment-spot the vertebrate eye doubtless has its origin. In the hagfishes, which stand next highest in the series, the eye, still incomplete, is very small and hidden by the skin and muscles. This condition is very different from that of the blind fishes of the higher groups, in which the eye is lost through atrophy, because in life in caves, or under rocks, the organ is no longer necessary.

The Ear of the Fish.— The ear of the typical fish consists of the labyrinth only, including the vestibule and three semi-circular canals, these dilating into one or more sacs which contain large, loose bones, the ear-stones or otoliths. There is no external ear, no tympanum, and no Eustachian tube. The ear-sac on each side is lodged in the skull or at the base of the cranial cavity. It is commonly surrounded by bone, but sometimes it lies near a fontanel or opening in the skull above.

The otoliths, two in each labyrinth, are usually large firm bones with enameled surface and peculiar grooves and markings. Each species has its peculiar type, but they vary much in different groups of fishes. The sense of hearing in fishes cannot be very acute, and is probably confined chiefly to the perception of disturbances in the water. Most movements of the fish are governed by sight rather than by sound.

Voices of Fishes.— Some fishes make distinct noises, variously described as quivering, grunting, grating, or singing. The name grunt is applied to species of ***Hæmulon*** and related genera, and fairly describes the sound these fishes make. The Spanish name ***ronco*** or ***roncador*** (grunter or snorer) is applied to several fishes, both sciænoid and hæmuloid. The noise made by these fishes may be produced by forcing air from part to part of the complex air-bladder, or it may be due to grating one on another of the large pharyngeals. The grating sounds arise, no doubt, from the pharyngeals, while the quivering or singing sounds arise in the air-bladder. The midshipman, ***Porichthys notatus***, is often called singing-fish, from a peculiar sound it emits. These sounds may possibly be useful to the species, but they are not well differentiated, nor have they been so investigated as to be well understood.

Sense of Taste.— It is probably certain that fishes possess a sense of taste, though it is little differentiated, and is in some species located in the barbels about the mouth. The tongue is without delicate membranes or power of motion. In some fishes certain parts of the palate or pharyngeal region are well supplied with nerves, but no direct evidence exists that these have a function of discrimination among foods. Fishes swallow their food very rapidly, often whole; and mastication, when it takes place, is a crushing or cutting process, not one likely to be affected by the taste of the food.

Sense of Touch.— The sense of touch is better developed among fishes. Most of them flee from contact with actively moving objects. Many fishes use sensitive structures as a means of exploring the bottom, or of feeling their way to their food. The barbel or fleshy filament, wherever developed, is an organ of touch. In some fishes, as the moray, barbels are outgrowths from the nostrils. In the catfish the principal barbel grows from the rudimentary maxillary bone. In the horned dace and gudgeon the little barbel is attached to the maxillary. In other fishes barbels grow from the skin of the chin or snout. In the goat-fish and surmullet the two chin-barbels are highly specialized. In the codfish the single beard is little developed. In the gurnards and related forms, the lower rays of the pectoral are separate and barbel-like. Detached rays of this sort are found in the threadfins, and in various other fishes. Barbels or fleshy flaps are often developed over the eyes, and sometimes on the scales or the fins.

The sense of pain is very feeble among fishes. A trout has been known to bite at its own eye, placed on a hook, and similar insensibility has been noted in the pike and other fishes. «The Greenland shark, when feeding on the carcass of a whale, allows itself to be repeatedly stabbed in the head when abandoning its prey.»

The Nervous System.— The nervous system in the fish, as in the higher vertebrates, consists of brain and spinal cord, with sensory or afferent and motor or efferent nerves. As in other vertebrates, the nerve-substance is divided into gray matter and white matter, or nerve-cells and nerve-fibres. In the fish, however, the whole nervous system is relatively small, its structures feeble, and the gray matter less developed than in the higher forms. According to Günther, the brain in the pike (*Esox*) forms but 1-1305th part of the weight of the body; in the burbot (*Lota*) about 1-720th part.

The cranium in fishes is relatively small, but the brain does not nearly fill its cavity, the space between the dura mater, which lines the skull cavity, and the arachnoid membrane, which envelops the brain, being filled with a soft fluid containing a quantity of fat.

It is most convenient to examine the fish-brain in its higher stages of development, as seen in the sun-fish, striped bass or perch. As seen from above, the brain of a typical fish seems to consist of five lobes or ganglia, four of them in pairs, the fifth posterior to these on the median line. The posterior lobe is the cerebellum or metencephalon, and it rests on the broadened termination of the spinal cord, called the medulla oblongata.

In front of the cerebellum lies the largest pair of lobes, each of them hollow, the optic nerves being attached to the lower surface. These are known as the optic lobes or mesencephalon. In front of these lie the two lobes of the cerebrum, also called the hemispheres, the prosencephalon. These lobes are usually smaller than the optic lobes and solid. In some fishes they are covered by a fold, but are never corrugated, as is the brain of the higher animals. In front of the cerebrum lie the two small olfactory lobes, which receive the large olfactory nerves from the nostrils.

In the hollow of the optic lobe are small protuberances, supposed to represent the corpora quadrigemina of the higher vertebrates. From its lower surface is suspended the hypophysis or pituitary gland.

In most of the bony fishes the structure of the brain does not differ materially from that seen in the perch. In the sturgeon, however, the parts are more widely separated, so that the connecting nerve-substance is more clearly seen between the several parts. In the dipnoans the cerebral hemispheres are united, while the optic lobe and cerebellum are very small. In the sharks and rays the large cerebral hemispheres are usually coalescent into one, and the olfactory nerves dilate into large ganglia below the nostrils. The optic lobes are smaller than the hemispheres and also coalescent. The cerebellum is very large, and the surface of the medulla oblongata is more or less modified or specialized.

Besides the structures noted in other fishes, the epiphysis or pineal organ is largely developed in sharks, and traces of it are found in most or all of the higher vertebrates. In some of the lizards this epiphysis is largely developed, bearin at its tip a rudimentary eye. This leaves no doubt that in these forms it has an optic function. For this reason the structure, wherever found, has been regarded as a rudimentary eye, and the «pineal eye» has been called the «unpaired median eye of chordate» animals.

It has been supposed that this eye, once possessed by all vetrebrate forms, has been gradually lost with the better development of the paired eyes, being best preservd in reptiles as «an outcome of the life-habit which concealed the animal in sand or mud and allowed the forehead surface alone to protrude, the median eye thus preserving its ancestral value in enabling the animal to look directly upward and backward.» In none of the fishes is the epiphysis more than a nervous enlargement, and neither in fishes nor in amphibia is there the slightest suggestion of its connection with vision. It seems probable, as suggested by Dr. Hertwig, that the original function of the pineal body was a nervous one, and that its connection with, or development into, a median eye in lizards was a modification of a secondary character.

The brain of the cyclostomes (hagfishes and lampreys) differs widely from that of the higher fishes, and the homologies of the different parts are still uncertain. The different ganglia are all solid and are placed in pairs. It is thought that the cerebellum is wanting in these fishes, or represented by a narrow commissure (*corpus restiforme*) across the front of the medulla. In the lancelet there is no trace of brain, the band-like spinal cord tapering toward either end.

The spinal cord extends from the brain to the tail, passing through the neural arches of the different vertebræ when these are developed. In the higher fishes it is cylindrical and inelastic. In a few fishes (head-fish, trunk-fish) in which the posterior part of the body is shortened or degenerate, the spinal cord is much shortened, and replaced behind by a structure called cauda equina. In the head-fish it has shrunk into «a short and conical appendage to the brain.» In the cyclostomes and chimæras the spinal cord is elastic, and more or less flattened or band-like, at least posteriorly.

The nerves of the fish correspond in place and function with those of the higher animals. They are, however, fewer in number, both large nerve-trunks and smaller nerves being less developed than in higher forms. The olfactory nerves and optic nerves may be regarded as outgrowths of the brain. The olfactory nerves, or first pair, extend through the ethmoid bone to the nasal cavity, which is typically a blind sac, with two roundish openings, but is subject to many variations. The optic nerves, or second pair, extend from the eye to the base of the optic lobes. In cyclostomes these nerves run from each eye to the lobe of its own side. In the bony fishes or *Teleostci* each runs from the eye to the lobe of the opposite side. In the sharks, rays, chimæras, and ganoids the two optic nerves are joined in a chiasma as in the higher vertebrates. The other nerves arising in the brain need not be mentioned in detail.

A sympathetic system coresponding to that found in the higher vertebrates is found in all the *Teleostei* or bony fishes, and in the body of sharks and rays when it is not extended to the head.

The operations of the nervous system in fishes are essentially those of the higher vertebrates, the instincts being relatively weak and the intellect or power of choice among competing responses to external stimulus being apparently wanting. All acts of the fish may be regarded as reflex, the results of external stimulus or of stimulus arising within the body of the fish. These actions in each species tend to run in grooves or to be repeated in a special way for each species. These ways constitute the habits of the fish.

Organs of Reproduction.— In most fishes the germ-cells are produced in large sacs (ovaries, testes) arranged symmetrically one on either side of the posterior part of the abdominal cavity. The sexes are generally but not always similar externally, and may be distinguished on dissection by the difference between the sperm-cells and the ova. The ovary with its eggs is more yellow in color and the contained cells appear granular. The testes are whitish or pinkish, their secretion milk-like and, to the naked eye, not granular.

In a very few cases both organs have been found in the same fish as in Serranus, but all fishes seem to be normally diœcious, the two sexes in different individuals. There are no external genital organs, but in some species a papilla or tube is developed at the end of the urogenital sinus. This may exist in the breeding season only, as in fresh-water lampreys, or it may persist through life, as in some gobies.

The great majority of fishes are oviparous, the egg-cells being fertilized after deposition. The eggs are laid in gravel or sand or other places suitable for the species, and the milt or sperm-cells of the male is discharged over or among them in the water. A very small quantity of the sperm-fluid may impregnate a large number of eggs. In a number of families the species are ovoviviparous, the eggs being hatched in the ovary or in a dilated part of the oviduct. In no case is a real uterus developed. In the case of viviparous fishes actual copulation takes place, and there is usually a modification of some organ to effect transfer of the sperm-cells. This may be the sword-shaped form of the anal fin in many top-minnows, the fin itself being placed in advance of its usual position.

It may be an alteration of the structure of part of the anal fin as in the surf-fishes (*Embiotocidæ*); or, as in the *Elasmobranchi*, large bony organs (claspers) may be developed from the ventral fins.

In some viviparous fishes, as the rock-fishes and rose-fishes, the young fishes are very minute at birth. In others, as the surf-fishes, they are relatively large and few in number. In the viviparous sharks, which constitute the majority of the species, the young are large at birth and prepared to take care of themselves.

The eggs of fishes vary much in size and form. In those sharks and rays which lay eggs the ova are deposited in a horny egg-case, in color and texture suggesting the kelp in which they are laid. The eggs of the bull-head sharks (*Heterodontus*) are spirally twisted, those of the cat-sharks (*Scyliorhinidæ*) quadrate, with long filaments at the angles. Those of rays are wheelbarrow-shaped, with four handles. One egg-case may sometimes contain several eggs, and develop several young. The eggs of lancelets are small, but those of hagfishes and lampreys are large, ovate, with fibres at each end, each with a triple hook at tip. The chimæras have also large egg-cases, oblong in form.

In the higher fishes the eggs are spherical, large or small according to the species, and varying in the firmness of their outer walls. All contain food-yolk from which the embryo in its earlier stages is fed. The eggs of the eel (*Anguilla*) are microscopic. According to Günther, 25,000 eggs have been counted in the herring, 155,000 in the lumpfish, 3,500,000 in the halibut, 7,635,200 in the sturgeon, and 9,344,000 in the cod. Smaller numbers are found in species with large ova. Where an oviduct is present, the eggs are often poured out in glutinous masses, as in the bass. When, as in the salmon, there is no oviduct, the eggs lie separate and do not cohere together. It is only with the latter class of fishes, those in which the eggs remain distinct, that artificial impregnation and hatching are practicable. In this regard, the value of the salmon and trout is pre-eminent. In some fishes the ovary of but one side is developed.

In most fishes the parents take no care of their eggs or young. In a catfish (*Bunocephalus*) the eggs adhere to the under surface of the females. In a kind of pipefish (*Solenostomus*) a large pouch for retention of the eggs is formed on the belly of the female. In the sea-horses and pipefishes a pouch is formed in the skin, usually underneath the tail of the males. Into this the eggs are thrust, and here the young fishes hatch out, remaining until large enough to take care of themselves.

In certain sea catfishes the male carries the eggs in his mouth, thus protecting them from the attacks of the female. In numerous cases the male constructs a rough nest, which he defends against all intruders, against the female as well as against outside enemies. The nest-building habit is especially developed in the sticklebacks (*Gasterosteidæ*), a group in which the male fish, though a pigmy in size, is very fierce in disposition. In a minnow of Europe (*Rhodeus amarus*) the female is said to deposit her eggs within the shells of river mussels.

In the relatively few cases in which the sexes are unlike, the male is usually the brighter in color and with more highly developed fins. Blue, red, black, and silvery white pigment are especially characteristic of the male, the olivaceous and mottled coloration of the female. Sometimes the male has a larger mouth, or better developed crests, barbels, or other appendages. In some species the pattern of coloration in the two sexes is essentially different.

In various species the male develops peculiar structures not found in the female, and often without any visible purpose. In the male chimæra, a peculiar cartilaginous hook, armed with teeth at the tip, is developed in the male only. In the skates or true rays (*Raja*) the pectoral fin has near its edge two rows of stout incurved spines. These the female lacks.

In the breeding season the male sometimes becomes much brighter by the accumulation of bright red or blue pigment, black or white pigment-cells. This is especially true in the minnows, darters, and other fresh-water species which spawn in the brooks of northern regions in the spring. In the minnows and suckers horny excrescences are also developed on head, body, or fins, to be lost after the deposition of the spawn.

In the salmon, especially those of the Pacific, the adult male becomes greatly distorted in the spawning season, the jaws and teeth being greatly elongated, and hooked or twisted so that the fish cannot shut its mouth. After the act of spawning, all the individuals of these species die, both male and female. The Atlantic salmon and the trout show also some elongation of the jaws, but not to the same extent, and in these species the individuals mostly survive the act of spawning.

In fishes generally the eggs are laid in the spring, to be hatched in warming water. Among the salmon, trout, and cod-fishes, a reverse condition obtains. The eggs are laid in fall or winter, being deposited in water which is growing colder, hatching when the temperature of 54° F. is passed. In those fishes which pair, the relation seems not to be permanent, nor is anything to be called affection recorded among them.

Embryology and Growth of Fishes.— The egg of the fish develops only after fertilization, the union of its nuclear substance with that of a sperm-cell from the male. When this process, known as amphimixis, takes place, the egg is ready to begin its segmentation. The eggs of all fishes contain more or less of food-yolk attached to the structures of the germ-cell proper and included with it in the same spherical mass. The presence of this food-yolk affects the manner of segmentation.

The process of cell-division or segmentation common among fishes need not be described in detail, as it is essentially that of the higher vertebrates. When the food-substance or yolk is consumed, and the little fish is able to shift for itself, it leaves the egg-envelopes and is said to be hatched.

The young fish usually differs from the adult chiefly in size and proportions. The eye is larger, the head larger, the fins are lower, the appendages less developed, and the body more slender in the young than in the adult. But to most of these distinctions there are numerous exceptions, and in some fishes there is a change so marked as to be fairly called a metamorphosis. In such case the young fish in its first condition is properly called a larva. The larva of the lamprey (*Petromyzon*) is nearly blind and toothless, with slender head, and was long supposed to belong to a different genus from the adult. The larva of sharks and rays and of some dipnoans are provided with bushy external gills, which disappear in the process of development. In most soft-rayed fishes the embryonic fringe, which precedes the development of the vertical fins, persists for a considerable time.

Hybridism is very rare among fishes in a state of nature. Two or three peculiar forms among the snappers (*Lutianus*) in Cuba seem fairly attributable to hybridism, the single specimen of each showing a remarkable mixture of characters belonging to two common species. Hybrids may be readily made in artificial impregnation among those fishes with which this process is practicable. Hybrids of the different salmon or trout usually share nearly equally the traits of the parent species.

The age of fishes is seldom measured by a definite period of years. Most of them grow as long as they live, and apparently live until they fall victims to some stronger species. It is reputed that carp and pike have lived for a century, but the evidence needs verification. Some fishes, as the salmon of the Pacific (*Oncorhynchus*) have a definite period of growth (usually four years) before spawning. After this act all the individuals die — so far as known — without exception.

Fishes differ greatly in tenacity of life. In general, fishes of the deep seas die at once if brought near the surface. This is due to the reduction of pressure. This forces the stomach out through the mouth and may burst the air-bladder and the large blood-vessels. Marine fishes usually die very soon after being drawn out from the sea. Some fresh-water fishes are very fragile, dying soon in the air, often with injured air-bladder or blood-vessels. They will die even sooner in foul water. Other fishes are extremely tenacious of life. The mud-minnow (*Umbra*) is sometimes plowed up in the half-dried mud of Wisconsin prairies. The related Alaska black-fish (*Dallia*) has been fed frozen to dogs, and has escaped alive from their stomachs after being thawed out. Many of the catfishes (*Ameiurus*) will live after lying half-dried in the dust for hours. The dipnoan (*Lepidosiren*) lives in a ball of half-dried mud during the dry season, and the fishes, mostly Asiatic, with accessory breathing organ, can long maintain themselves out of water.

Some fishes can readily resist starvation, while others succumb as readily as a bird or mammal. The limits of distribution of many fishes are marked by changes in temperature. Few marine fishes can endure any sudden or great change in this regard, although fresh-water fishes adapt themselves to the seasons. Those fishes which are tenacious of life and little sensitive to changes in climate and food are most successfully acclimatized or domesticated. The Chinese carp (*Cyprinus carpio*) and the Japanese goldfish (*Carassius auratus*) have been naturalized in almost all temperate and tropical river-basins. Within the limits of clear, cold waters, most of the salmon and trout are readily transplanted. But some of these, as the grayling, are very sensitive to the least change in conditions. Most of the catfish (*Siluridæ*) will thrive in almost any fresh waters except those which are very cold.

The eggs of many salmon placed on ice to retard their development have been successfully transported to great distances. The king salmon has been thus transferred from California to Australia. It has been found possible to stock rivers and lakes with desirable species, or to restock those in which the fish-supply has been partly destroyed, through the means of artificially impregnated eggs.

Fishes have little power to reproduce lost parts. Only the tips of fin-rays or filaments are thus restored after injury. Sometimes a fish in which the tail has been bitten off will survive the injury. The wound will heal, leaving the animal with a truncate body, fin-rays sometimes arising from the wounds.

Fishes as Food for Man.— Among all races of men fishes are freely eaten as food, either raw, as preferred by the Japanese and Hawaiians, or else as cooked, salted, dried, or otherwise preferred.

The flesh of most fishes is white, flaky, readily digestible, and with an agreeable flavor. Some, as the salmon, are charged with oil, which tends to give an orange hue known as salmon-color. Others have colorless oil which may be of various consistencies. Some have dark red flesh, which usually contains a heavy oil that becomes acrid when stale. Some fishes, as the sharks, have tough, coarse flesh. Some have flesh which is watery and coarse; some are watery and tasteless. Some, otherwise excellent, have the muscular area, which constitutes the chief edible part of the fish, filled with small bones.

The writer has tasted most of the noted food fishes of the northern hemisphere. First in the ranks as a food-fish (when properly cooked, for he is no judge of raw fish) he would place the eulachon or candlefish (*Thaleichthys pacificus*). This little smelt, about a foot long, ascends the Columbia River, Frazer River, and streams of Southern Alaska in the spring, in great numbers, for the purpose of spawning. Its flesh is white, very delicate, charged with a white and very agreeable oil, readily digested, and with a sort of fragrance peculiar to the species.

Next to this he is inclined to place the ayu (*Plecoglossus altivelis*), a sort of dwarf salmon, which runs in similar fashion in the rivers of Japan and Formosa. The ayu is about as large as the eulachon, and has similar flesh, but with little oil and no fragrance.

Very near the first among sea-fishes must come the pompano (*Trachinotus carolinus*) of the Gulf of Mexico, with firm, white, finely flavored flesh.

The red surmullet of Europe (*Mullus barbatus*) has been long famed for its delicate flesh, and may perhaps be placed next. Two related species in Polynesia, the *Pseudupeneus bifasciatus* and *Pseudupeneus porphyreus*, are scarcely inferior to it.

Side by side with these belongs the whitefish (*Coregonus clupeiformis*) of the Great Lakes. Its flesh, delicate, slightly gelatinous, moderately oily, is extremely agreeable. It has long been known among hunters that one can eat the flesh of this fish longer than any other without the feeling of cloying. The salmon cannot be placed in the front rank because, however, excellent, the stomach soon becomes tired of it.

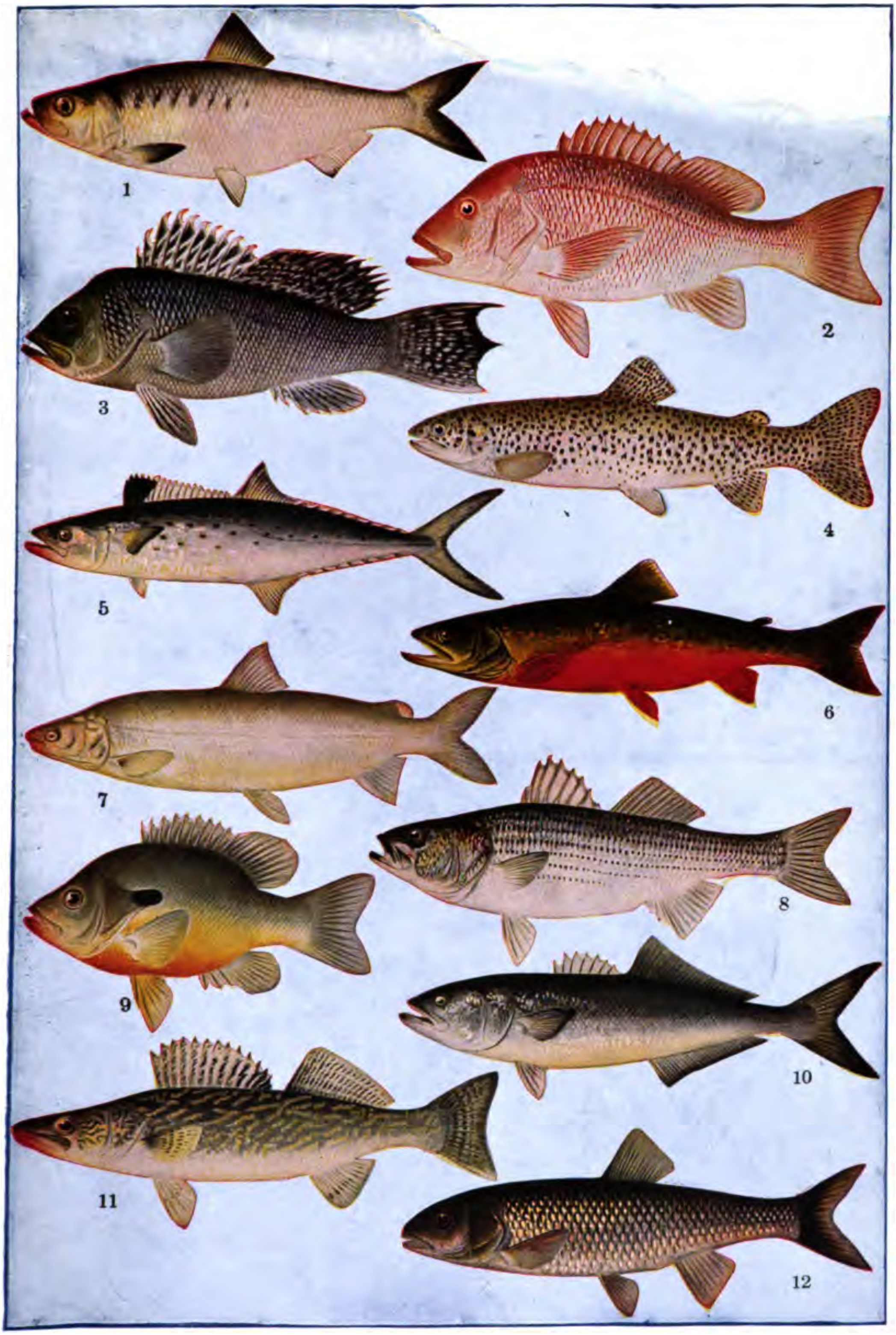
The Spanish mackerel (*Scomberomorus maculatus*), with flesh at once rich and delicate; the great opah (*Lampris luna*), still richer and more delicate; the bluefish (*Pomatomus saltatrix*), similar, but a little coarser; and the kingfish (*Scomberomorus cavalla*) firm and well-flavored, represent the best of the fishes allied to the mackerel.

The shad (*Alosa sapidissima*), with its sweet, tender, finely oily flesh, stands also near the front among food-fishes, but it runs above all others in the matter of small bones. The weakfish (*Cynoscion regalis*) and numerous relatives rank first among those with tender, white, savorous flesh. Among the bass and perch-like fishes, common consent places near the first the striped bass (*Roccus lineatus*), the bass of Europe (*Dicentrarchus labrax*), the susuki of Japan (*Lateolabrax japonicus*), the red tai of Japan (*Pagrus major*), the sheepshead (*Archosargus probatocephalus*), the muttonfish or pargo criollo of Cuba (*Lutianus analis*), the European porgy (*Pagrus pagrus*), the uku (*Aprion virescens*) of Hawaii, the spadefish (*Chætodipterus faber*), and the black bass (*Micropterus dolomieu*).

The various kinds of trout have been made famous the world over. All are attractive in form and color; all are gamy; all have the most charming of scenic surroundings; and finally, all are excellent as food-fishes — not in the first rank, perhaps, but well above the second. Notable among these are the European charr (*Salvelinus alpinus*), the American speckled trout (*Salvelinus fontinalis*), the dolly varden (*Salvelinus malma*), and the oquassa trout (*Salvelinus oquassa*). Less attractive are the true trout, the brown trout or Forelle in Europe (*Salmo fario*); the rainbow trout (*Salmo irideus*), the steelhead trout (*Salmo gairdneri*), the tahoe trout (*Salmo henshawi*), and the cutthroat trout (*Salmo clarkii*) in America; and the yamabe (*Salmo perryi*) of Japan. Not least of all these is the grayling (*Thymallus*), of different species in the streams of northern regions.

All these are the choicest prizes of the angler, and they have few rivals in any part of the world. Other most excellent food-fishes are the eel (*Anguilla* species), the sole of Europe (*Solea solea*), the pike (*Esox lucius*), the muskallonge (*Esox masquinongy*), the sardine (*Sardinia pilchardus*), the atka-fish (*Pleurogrammus monopterygius*) of Bering Sea, the pescado blanco (*Chirostoma estor* and other species) of Lake Chapala in Mexico, the Hawaiian mullet (*Mugil cephalus*), the California pesce rey (*Atherinopsis californiensis*), the Channel catfish (*Ictalurus furcatus*), the turbot (*Psetta maxima*), the barracuda (*Sphyræna*), and the young of various sardines and herring known as whitebait. Of large fishes, probably the swordfish (*Xiphias gladius*), the halibut (*Hippoglos-*

AMERICAN FOOD FISHES



1. Alewife.
2. Red Snapper.
3. Black Sea-bass.
4. Steel-head.
5. Spanish Mackerel.
6. Rainbow Trout.
7. Whitefish.
8. Striped Bass.
9. Sunfish.
10. Bluefish.
11. Sauger.
12. Fall-fish.

sus hippoglossus), and the king-salmon or quinnat (*Oncorhynchus tschawytscha*) may be placed first. Those who feed on raw fish prefer, in general, the large parrot-fishes (as *Pseudoscarus jordani*) in Hawaii, or else the young of mullet and similar species.

In general, the economical value of any species depends not on its toothsomeness, but on its abundance and the ease with which it may be caught and preserved.

It is said that more individuals of the herring (*Clupea harengus* in the Atlantic; *Clupea pallasii* in the Pacific) exist than of any other species. The herring is a good food-fish, and wherever it runs it is freely caught. According to Björnson, wherever the schools of herring touch the coast of Norway, there a village springs up, and this is true in Scotland, Newfoundland, and from Killisnoo in Alaska to Otaru in Japan and to Strielok in Siberia. Goode estimates the herring product of the North Atlantic at 1,500,000,000 pounds annually. In 1881, Prof. Huxley used these words:

> It is said that 2,500,000,000, or thereabouts, of herrings are every year taken out of the North Sea and the Atlantic. Suppose we assume the number to be 3,000,000,000 so as to be quite safe. It is a large number, undoubtedly, but what does it come to? Not more than that of the herrings which may be contained in one shoal, if it covers half a dozen square miles, and shoals of much larger size are on record. It is safe to say that scattered through the North Sea and the Atlantic, at one and the same time, there must be scores of shoals, any one of which would go a long way toward supplying the whole of man's consumption of herrings.

The codfish (*Gadus callarias* in the Atlantic; *Gadus macrocephalus* in the Pacific) likewise swarms in all the northern seas, takes the hook readily, and is better food when salted and dried than it is when fresh.

Next in economic importance probably stands the mackerel of the Atlantic (*Scomber scombrus*), a rich oily fish which bears salting better than most.

Scarcely less important is the great king-salmon or quinnat (*Oncorhynchus tschawytscha*) and the blueback salmon or red salmon (*Oncorhynchus nerka*). The canned product of the latter in Alaska alone amounts to nearly $5,000,000 annually.

The salmon of the Atlantic (*Salmo salar*), the various species of sturgeon (*Acipenser*), the sardines (*Sardinia*), the halibut (*Hippoglossus*), are also food-fishes of great importance.

In the tropics no one species is represented by enormous numbers of individuals, as is the case in colder regions. On the other hand, the number of species regarded as food-fishes is much greater in any given part. In Havana about 350 different species are sold as food in the markets, and an equal number are found in Honolulu. Upward of 600 different species appear in the markets of Japan. In England, on the contrary, about 50 species make up the list of fishes commonly used as food. Yet the number of individual fishes is probably not greater about Japan or Hawaii than on a similar stretch of British coast.

Catching Fishes.— In general, fishes are caught in four ways, by baited hooks, by spears, by traps and by nets. Special local methods, such as the use of the tamed cormorant, in the catching of the ayu, by the Japanese fishers at Gifu, may be set aside for the moment, and all general methods of fishing come under one of these four classes.

Of these methods, the hook, the spear, the seine, the beam-trawl, the gill-net, the purse-net, the sweep-net, the trap, and the weir are most important. The use of the hook is again extremely varied. Sometimes for codfish long sunken lines, each baited with many hooks, are used. For pelagic fish a baited hook is drawn swiftly over the surface, with a «spoon» attached which looks like a living fish. In the rivers the line is attached to a pole, and when fish are caught for pleasure or for the joy of being in the woods, recreation rises to the dignity of angling. Angling may be accomplished with a hook baited with an earthworm, a grasshopper, or the larva of some insect. The angler of to-day, however, prefers the artificial fly, as being more workman-like and also more effective than bait-fishing.

With the multiplicity of apparatus for fishing, there is the greatest variety in the boats which may be used. The fishing fleet of any part of the world is a most interesting object, as are also the fishermen with their quaint garb, plain speech, and their strange songs and calls with the hauling-in of the net.

Evolution of Fishes.— When a fish dies its body is at once attacked by hundreds of creatures ranging from the one-celled protozoa and bacteria to individuals of its own species. Its flesh is devoured, the bones are scattered, the gelatinous substance in them decays, and the phosphate of lime is in time dissolved in the water. For this reason few fishes of the millions that die each year leave any trace for future preservation. At the most, a few teeth, a fin-spine, or a bone buried in the clay might remain intact or in such condition as to be recognized.

But now and then it happens that a dead fish may fall in more fortunate conditions. On a sea-bottom of fine clay the bones, or even the whole body, might be buried in such a way as to be sealed up and protected from total decomposition. The flesh would in any case disappear and leave no mark, or at the most a mere cast of its surface. But the hard parts might persist, and now and then they do persist, the lime unchanged or else silicified or subjected to some other form of chemical substitution. Only the scales, the teeth, the bones, the spines and the fin-rays can be preserved in the rocks of sea or lake bottom. In a few localities, as Fossil Station, near Green River, Wyo., Monte Bolca in Tuscany, and Mount Lebanon in Syria, and in lithographic slates in Germany, many skeletons of fishes have been found pressed flat in layers of very fine rock, their structures traced as delicately as if actually engraved on the smooth stone. Fragments preserved in ruder fashion abound in the clays and even the sandstones of the earliest geological ages. In most cases, however, fossil fishes are known from detached and scattered fragments, many of them, especially of the sharks, by the teeth alone. Fishes have occurred in all ages from the Lower Silurian or Ordovician to the present time, and no doubt the very first lived before the Silurian.

No one can say what the earliest fishes were like, nor do we know their real relation to the worms, their presumable ancestors, nor to the tunicates and other chordate forms, not fish-like, but still degenerate relatives of the primitive fish.

From analogy we may suppose that the first fishes which ever were, bore some resemblance to the lancelet, for that is a fish-like creature with every structure reduced to its lowest terms. But as the lancelet has no hard parts, no bones, nor teeth, nor scales, nor fins, no traces of its kind are found among the fossils. If the primitive fish was like it in important respects, all record of it has necessarily vanished from the earth.

The next group of living fishes, the cyclostomes, including the hagfishes and lampreys, fishes with skull and brain but without limbs or jaws, stands at a great distance above the lancelet in complexity of structure, and equally far from the true fishes in its primitive simplicity. In fact, the lamprey is farther from the true fish in structure than a perch is from an eagle. Yet for all that, it may be an offshoot from the primitive line of fish-descent. There is not much in the structure of the lamprey which may be preserved in the rocks and no trace of fossil lamprey is actually known to exist.

The oldest unquestioned fragments of fishes have been very lately made known by Charles D. Walcott, from rocks of the Trenton Period in the Ordovician or Lower Silurian. These are from Cañon City, Col. Among these is certainly a small ostracophore (*Asterapis desiderata*). With it are fragments of a vertebral column, thought doubtfully to belong to an extinct type of chimæras (*Dictyorhabdus*) and other fragments of bony plates, referred with some doubt to the crossopterygian genus *Eriptychius*. This renders certain the existence of ostracophores at this early period, and their association with chimæras and primitive sharks is also probable. These early remains were from shallow, muddy water, more favorable perhaps for ostracophores than for sharks.

The fish-remains next in age in America are from the Bloomfield sandstone in Pennsylvania, of the Onondaga Period in the Silurian; the earliest in Europe are found in the Ludlow shales, both of these being in or near the horizon of the Niagara rocks, in the Upper Silurian Age.

It is, however, certain that these Ordovician remains do not represent the beginning of fish-life. Doubtless sharks, ostracophores and arthrodires, with perhaps chimæras, crossopterygians, and dipnoans existed at a far earlier period, preceded by unarmed, limbless forms, without jaws, of which no trace whatever has been left.

Next appear more or less simultaneously, in the early or middle Silurian, fin-spines, thought to belong to primitive sharks, remains of acanthodean and other sharks, and with these numerous bony shields of the mailed ostracophores, and somewhat later those of the more highly specialized arthrodires. Later appear cestraciont sharks, chimæras, dipnoans, and crossopterygians.

In the Devonian Age the ostracophores increase in size and abundance, disappearing with the beginning of the Carboniferous. The arthrodires also increase greatly in variety and in size, reaching their culmination in the Devonian, but not disappearing entirely until well in the Carboniferous.

These two groups (often united by geologists under the older name placoderms, given by McCoy), together with sharks and chimæras, made up almost exclusively the rich fish-fauna of Devonian times. The sharks were chiefly acanthodian and cladoselachean (*Pleuropterygii*), so far as our records show. The supposedly most primitive known type, that of *Cladoselache*, appeared in the middle Devonian. The *Ichthyotomi* (*Pleuracanthus*), sometimes regarded as still more primitive, are not known before the Carboniferous. In any case it is clear that the records of early shark-life are still incomplete. Chimæroids abound in the Devonian, and with them a considerable variety of crossopterygians and dipnoans. The true fishes appear also in the Devonian, in the guise of ganoid ancestors and relatives of *Palæoniscum*, all these with diamond-shaped enameled scales. In the Devonian, too, we find the minute, lamprey-like forms, our ignorance of which is concealed under the name *Cycliæ*.

In the Carboniferous Age the sharks increase in number and variety, the ostracophores disappear, and the arthrodires follow them soon after, in the Permian. Other forms of dipnoans, crossopterygians, and some ganoids follow, giving the fauna a somewhat more modern aspect. The *Acanthodei* and *Ichthyotomi* pass away with the Permian, which follows the period of coal.

In the Triassic the earlier types of ganoids give place to forms approaching the gar-pike and sturgeon. The crossopterygians rapidly decline. The dipnoans are less varied and fewer in number, and notidanoid sharks make their first appearance. All the ancient types of shark meanwhile have passed away, the *Cestraciontes* being the only group continued from the Permian to the Triassic. Here are found the first true bony fishes, derived from ganoid stock, the allies and predecessors of the great group of herrings. These become more numerous in the Jura, and in this age appear other forms which give the fish-fauna of this period something of a modern appearance. In this age the sharks become divided into several groups, *Notidani*, cat-sharks, lamnoid sharks, angel-fishes, skates, and finally typical sharks, being well differentiated from each other. Chimæras are still numerous. The *Acanthodei* have passed away, as well as the mailed ostracophores and arthrodires. The dipnoans and crossopterygians are few. The early ganoids have given place to more modern types, still in great abundance and variety.

This condition continues into the Cretaceous Period. Here the rays and modern sharks increase in number. The ganoids hold their own, and other groups of soft-rayed fishes, as the smelts, the lantern-fishes, the pike, and the flying-fishes, join the group of herring-like forms which represent the modern bony fishes. In the Cretaceous appear the first spiny-rayed fishes, derived perhaps from pike-like forms, the ancestors of the living genus *Beryx*. From the berycoids spring the perch-like and mackerel-like forms so numerous in recent times.

In the Eocene great changes have taken place. The early families of bony fishes nearly all disappear. The herring, pike, smelt, salmon, flying-fish and berycoids remain, and a multitude of others seem to spring up to join them. Among these are the bowfins, the globe-fishes, the trigger-fishes, the catfishes, the eels, the butterfly-fishes, the porgies, the perch, the bass, the pipe-fishes, trumpet-fishes, the mackerels, and the John-dory, with the sculpins, the anglers, the flounders, the blennies, and the cods. That all these groups, generalized and specialized, arose at once is impossible, although all seem to date from Eocene times. Doubtless all of them had their origin in earlier times, and the simultaneous appearance is related to the fact of the thorough study of Eocene shales which have in numerous localities (Green River, London, Monte Bolca, Licata, Mount Lebanon) been especially favorable for the preservation of their forms. Practically fossil fishes have been studied only in a very few parts of the earth. Scotland, England, Germany, Italy, Switzerland, Syria, Ohio, and Wyoming have furnished the great bulk of all the fish-remains in existence. In some regions perhaps collections may be made which will give us a more just conception of the origin of the different groups of bony fishes. We can now only say with certainty that the modern families were largely existent in the Eocene, that they sprang from ganoid stock, found in the Trias and Jura, that several of them occurred in the Cretaceous also, that the berycoids were earliest of the spiny-rayed fishes, and forms allied to herring the earliest of soft-rayed forms. Few of the modern genera go back to the Eocene; many of them arose in the Miocene; and few species have come down to us from rocks older than the end of the Pliocene. The general modern type of the fish-faunas being determined in the later Cretaceous and the Miocene, the changes which bring us to recent times have largely concerned the abundance and variety of the individual species. From geological distribution we have arising the varied problems of geographical distribution, and the still more complex conditions on which depends the extinction of species and of types.

For much information on the fishing apparatus in use in America, the reader is referred to the reports of the Fisheries in the 10th census (1880), under the editorship of Dr. G. Brown Goode. In these reports Goode, Stearns, Earll, Gilbert, Bean, and the present writer have treated very fully of all economic relations of the American fishes. In an admirable work entitled ‘American Fishes’ Dr. Goode has fully discoursed of the food and game fishes of America, with especial reference to the habits and methods of capture of each. To these sources, and to many others of similar purport in other lands, the reader is referred for an account of the economic and the human side of fish and fisheries. See FISHES, GEOGRAPHICAL DISTRIBUTION OF; ICHTHYOLOGY.

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Fish Commission, in the United States, a bureau of the Department of Commerce and Labor, created by Congress in 1870, headed by the commissioner of fish and fisheries, with an assistant commissioner. It collects statistics of fisheries in the country, investigates the life histories and food of fish, and conducts experiments.

Fish-crow, a small species of crow (*Corvus ossifragus*), with a violet-green head, of the Atlantic coast, where it limits its wanderings to the sea-coast and tidal rivers, finding its food mainly along the beaches. It is perhaps the most destructive robber of birds' nests in the country. A similar species inhabits Cuba.

Fish Culture, or **Pisciculture,** the artificial propagation, fertilization, breeding, rearing, training and protecting of fishes, particularly food-fish. The art or industry was known in the early ages in China, and later in Germany and Sweden. In 1350, a monk, Dom Pinchon, hatched fish eggs by an artificial process, but the honor of introducing the modern plan of propagation is generally conceded to Stephen L. Jacobi, a Prussian soldier of Westphalia, who, in 1763, devised the process now in use in Europe and the United States, of stripping the ova from the female fish and mixing them with milt taken from the male. Fifty years after Jacobi's discovery, Joseph Remy, a fisherman of the Vosges Mountains, made the further discoveries upon which the culture depends — that the impregnation of fish eggs differs from that of all other oviparous animals in taking place after the eggs have left the body of the creature, and can therefore be performed as well artificially as by the animals themselves.

The first government fish culture station was established in 1850 at Hüningen, Alsace, and the following year a similar institution was established on the Tay in Great Britain. The process was introduced in the United States in 1865, when Dr. Garlick of Cold Springs, N. H., imported salmon eggs from Canada to hatch in the waters of his trout ponds. The process was also introduced in other sections of the country. The United States Commission of Fish and Fisheries, established by Congress 9 Feb. 1871, embraced in the scope of its work «the propagation of useful food-fishes, including lobsters, oysters, and other shellfish, and their distribution to suitable waters.»

Technically, the process now in use consists in taking the ripe eggs from the female fishes and the milt from the male, mixing them artificially, and leaving them until impregnation has been effected, after which the eggs separate of themselves, and are placed in water, washed and treated in different ways according to the species or variety of the fish. Those of the salmon are placed in a filter-box or trough, through which passes a stream of pure water, and left to hatch into «fry,» which process takes from 35 to 70 days. The advantage of pisciculture consists in the saving of multitudes of eggs which would otherwise be lost, the protection of the young fish from the dangers incident to their exposed condition, and the transplantation of species and varieties to other localities, where they soon become naturalized.

The operation for obtaining the ova and milt consists simply in pressing the body of the fish from the head toward the tail, and in collecting the excluded particles in a common vessel; the contents are occasionally put in motion in order to prevent the growth of parasites upon the eggs, which are very sure to destroy them. A low temperature and even desiccation is not necessarily fatal, so that many kinds in a nearly mature state may be transported for considerable distances. It has been estimated that 1,000,000 trout may be raised in this way at a cost of less than $200. Fish readily adapt themselves to new localities. Pickerel were easily introduced into ponds in Berkshire County, Mass., and the great pike of the north, ern lakes have been transplanted to the Connecticut River. The salt water smelt lives contentedly in ponds at Jamaica, Mass., and the tantog has found a new home in Massachusetts Bay. The expense of fish culture is small and the labor slight. There have been numerous inventions to aid the fish culturist, among them McDonald's fish-hatching jar which keeps the eggs in motion and automatically separates the dead fish from the living.

The United States government has established large salmon-breeding establishments in California and in Maine. It operates 28 hatcheries in various localities, owns 4 railroad cars for transporting eggs and young fish, and a steamer, the Fishhawk, is under its supervision. The vessel is in reality a floating hatchery. Western waters have been stocked with eastern fish and exhausted streams have been restored with a new supply. In 1901 the government planted 1,164,336,754 eggs and fishes in United States waters. Of this number nearly one fifth were shad and one fourth whitefish.

Aquatic birds are known to be of more or less assistance to the government in the dissemination of fish spawn. Naturalists tell us that these birds frequently carry the eggs from river to river and from lake to lake, by having their feet covered with the eggs. In the course of their flight the birds come to an inland sheet of water, or small creek, where they dive in or wade into the water, and the eggs are washed from their feet. In this way the waters become populated with new species and propagation progresses.

Fish culture has been found exceedingly profitable, too, as a private business or industry. There are over 400 fish hatcheries in Europe, and more than one half of these are owned by individuals. The Trout Pond Association, at Cold Springs, N. H., which began business in 1866, added a black bass branch in 1868, and erected salmon-breeding works in 1879, which in the first year yielded 450,000 eggs.

Several of the States have organized independent State Fish Commissions for the express purpose of disseminating the «fry» of food-fish in public waters. This is true of New York, whose commission of five members is appointed by the governor. Its principal office is at 83 Fulton Street, New York. The commission has established five hatcheries for the propagation of the «fry» from the eggs of the female fish, as follows: The Adirondack, Saranac; Cold Springs, Long Island; in Franklin County; Old Forge in the Fulton chain; at Newton Corners, and in Chautauqua County.

Fish Davit, in ship-building, a spar or small crane projecting from the bow of a ship for the suspension of the tackle, called the fish fall, used in hauling up the arms of the anchor in getting it aboard. The fish davit is such a distance abaft the cat-head as the length of the anchor may require, and is used to lift the fluke of the anchor to the bill-board: a roller keeps the fluke from bruising the vessel's side.

Fish Duck, a merganser (q.v.).

Fish-fly, one of the aquatic neuropterous insects of the family *Sialidæ,* and especially of the genus *Chauliodes,* represented by the hellgrammite and other species whose crawling larvæ are useful as fish-bait. See CORYDALIS.

Fish as Food in America. The question of the importance of fish as an article of food is no longer an open question. Recent food investigations have proved that it not only forms an economical source of variety to the diet, but that, like many other food materials, it also supplies the elements necessary for the building and repairing of the body as well as for maintaining the bodily heat required for energy and muscular work. With its protein, fat, and carbohydrates, the importance of its position has long been established, although the value of these properties differ in the dietary scale with the various fish, ranging in fuel value per pound from 40 calories represented by oysters in shells; 45 calories, shell crawfish and salted herring; and 65 calories for clams in shell, to 1,005 calories for canned salmon; 1,155 calories, canned salt mackerel; and 1,530 calories, caviare, as compared with 2,455 calories, the average value of beef, veal, and mutton; 1,670 calories, corn meal, and 1,655 calories, wheat flour.

Although the study of fish as a food is a wide subject, the most important difference that one detects in comparing the present with the past is represented in the method of preservation. Thus, for example, the method of salting and drying fish as practiced in Scandinavia is of the most remote antiquity, and as the aboriginal races in the Far North found it unnecessary, because of climatic conditions, to do anything more than dry their fish, this may be regarded as one of the earliest methods of preserving food for future use. The method of smoking fish to prepare them for eating unquestionably came later. In either instance, however, it was necessary that the work of curing should be performed as near the fishing ground as possible so it was to meet this requirement that the early Norse or Basque fishermen of the 12th and 13th centuries, as well as the English, French, and Spanish fishing fleets of the 16th and 17th centuries established so many colonies in the vicinity of the waters on which they sailed to fish.

From the earliest days of the history of this industry there has always been a great demand for cured fish, not only because it can be kept for a long time but also for its high nutrient qualities. As we have progressed in our knowledge of food compositions, therefore, we have applied our newly attained scientific knowledge to the improvement of the old methods of conservation, and yet, viewing our present achievements in the light of what we know about the past, we are compelled to admit that our present achievements are nothing more than a refinement of the methods that were pursued by the more ignorant fishermen several centuries ago.

The first attempt at refrigerating fish was made by Enoch Piper of Maine, but all his experiments were made in the British provinces. They were finally so successful that his methods were adopted by all large dealers in fish along the American seaboard with the result that fish, when the catch is in excess of the demand, is never lost but is stored in refrigerators until it can be disposed of at a fair price.

The invention of canning fish was perfected in Scotland, and was imported to this country in 1843, when a cannery for lobsters and mackerel was established at Eastport, Me. Owing to unfavorable legislation the lobster canning branch of the industry was not financially successful, but mackerel and other fish were preserved in this manner with profit to the canners. The canning of salmon, now one of the most important industries along the Pacific coast, dates from the year 1864. The product of this branch of the fishery industry was so successful from the date of its inception that it continued to increase its output until 1890 and 1891, when overproduction compelled the various companies to form a combine to regulate the product. Next to salmon, the sardine and its substitutes hold a position in the front rank of American canned fish. This branch of the industry was inaugurated in 1875, and, since that time, has presented a strong competition to the imported sardine. The centre of the sardine industry is in Maine.

As the canning industry is of comparatively recent origin some idea of its remarkable growth may be obtained by a glance at the Twelfth Census, in which it may be seen that, in the year 1900, the total value of the fish canned in the United States was $14,639,127, of which salmon was valued at $9,287,162, and the value of the sardine product at $4,212,351; the total value of the smoked fish was placed at $986,000, while that of the salted product was fixed at $5,260,927, of which sum cod alone represented about 60 per cent. Thus it may be seen that the total value of the American preserved fish industry was reported to be nearly $21,000,000 per annum.

Great as the demand for preserved fish has become the demand for the more natural fresh fish has also shown a constant increase. To have met such requirements a comparatively few years ago would have been impossible, whereas the more expeditious methods of transportation now enjoyed make the solution of this problem a simple one. In the old days of slow transportation fish was not shipped long distances, owing to the fact that it spoiled so easily, while this article of food is now transported from every part of the United States and Canada, to meet in the main centres of the commerce, where it is redistributed and shipped away again upon the largest scale possible.

The ever-increasing demand for all kinds of fish is partly explained by the increase in the population, but as the quantity of fish consumed per capita is also growing larger every day the question of the ability of the supply to withstand the demand has become an important one. To this there can be but one answer: So far as the deep-sea fish are concerned their number is practically inexhaustible, while, in the case of lake or river fish, as well as the various kinds of shell-fish, conditions are different.

Take, for example, the fishing grounds of Newfoundland. Discovered by the Cabots, they gave such an abundance of fish during the 16th century that no less than 5,000 men were steadily employed there. For nearly 400 years these same fishing banks have been the source of supply for a vast army of fishermen, and, although every kind of invention has been resorted to to increase the catch there has been no appreciable diminution of the staple fish in these waters.

So far as the rivers and lakes are concerned, however, this is not the case. There are some fish, called « anadromous,» which, like the salmon and the shad, return periodically to the fresh from the salt water. Born at the source of a river, they go down to the salt water for certain periods of their existence, but they always return to the place of their origin when under the influence of the instinct of reproduction. As fish are in their best edible condition at about the time when they are laying their eggs, men have conspired to catch them at this period, and as there is no time when they can be caught more easily, it would require nothing more than a series of nets cross-barring a river to catch practically every anadromous fish that ventured into the stream. A practical illustration of this may be found in the Columbia River. Once the finest salmon river in the world, it has now, from over-fishing, been almost depleted of its stock. So, too, the building of dams for manufacturing purposes in so many New England rivers has driven the anadromous fish to seek other spots to lay their eggs. To a certain extent the same thing is true, even in regard to the great American lakes. Vast as their extent may be they are still restricted areas of fresh water. As the result the range of fish is necessarily limited and if no effort were made to protect them, indiscriminate capture would inevitably lead to their complete destruction. It is wise and proper, therefore, that State Legislatures should pass laws restricting lake and river fishing to certain seasons and regulating the character of the nets to be used, the size of the meshes, etc.

The same principle not only holds good in regard to all kinds of shell-fish, but, especially so far as the oyster is concerned, the problem which is presented is a most serious one. The oyster-beds of Maryland and Virginia were at one time considered almost inexhaustible, but, as the demand for this bivalve has constantly increased, the almost ceaseless dredging for the oyster has shown that even such beds as those of Chesapeake Bay are unable to stand the demands made upon them. Fearful of the total extinction of the species, science has adopted every precaution to prevent such a possibility. Titles have been granted to oyster-beds, or privileges of dredging have been rented; the planting of oysters has been encouraged, and laws have been passed regulating the work of dredging. In spite of all these efforts, it is feared that the prolific day of the oyster has passed.

Clams, lobsters, and terrapin are among the other shell-fish that have shown the most serious effect of over-fishing. Clams are by no means as plentiful as they were a few years ago, and in some waters they have practically disappeared altogether, and while terrapin in the far South are still moderately abundant their over-capture has made them very scarce in more northern waters. For years lobsters have been steadily decreasing in number, a fact that is due not only to over-fishing but also in the indifference shown by their captors in regard to the age of the catch, and while legal restrictions were long ago placed upon the indiscriminate catching of this fish the difficulties found in enforcing the laws have prevented their successful operation.

It is not by legal enactment alone, however, that efforts have been made to increase the fish production of the country, for it is in this emergency that the new science of fish culture has exercised an important influence for good. While fish culture alone is unable to create fish the scientists have devoted themselves so closely to the spawning habits of the fish that they are now able to secure the fecundated eggs, to hatch them artificially, to rear the young fish, caring for them until they are old enough to supply their own wants, and then to introduce the young fry in large quantities in such rivers or lakes where, from over-fishing, or from some other known cause, such fish are scarce. It was many years ago that the attention of the Government was first called to this matter, and, in 1871, the demand for protective legislation became so great that the United States Fish Commission was established, with the late Spencer F. Baird at its head. It is only just, however, to state that the first practical efforts in the direction of sensible fish culture were made through the enterprise of a private body, the American Fish Culture Association, and it was largely due to the influence which they exerted that the Government consented to establish its bureau of fish culture. To-day, if never before, the wisdom of the introduction of scientific methods in the care and protection of fish is absolutely beyond question, for it is to the fish-culturist that we must look for our future supply of fresh water fish. It is that power that is engaged in planting the fingerling in our lakes and streams, that, in years to come, when the fish has had time to grow to full size, the American people may have the wholesome food that is in such great demand. Moreover, the question of the depletion of the shell-fish supply is also receiving attention from the scientists who are employed in this work, and while their efforts have not yet met with the success for which they may have hoped it is by no means impossible that they may yet devise some means of relieving the oyster and lobster situation.

According to the list of the fish sold in the New York market in 1804, it may be seen that, about a century ago, only 57 varieties were known, whereas, to-day, more than 75 different kinds of sea-products are offered for sale in the markets of any of the American seaboard cities, the number varying a little, of course, according to the season. It is chiefly during the past few years that the number of varieties has shown such marked increase, a circumstance which may be traced to the fact that improved railway facilities have made the transportation of this product from long distances thoroughly practicable. According to the census report for 1910 the total catch of the United States fishing industry was valued at $62,356,862, while the annual value of the oil and fertilizer derived from the menhaden fisheries was in excess of $3,000,000. See CANNING INDUSTRY.

Fish-hawk, or **Osprey.** This almost cosmopolitan bird is known throughout North America as the «fish-hawk,» never in popular speech as «osprey.» The species (*Pandion haliaëtus*) occurs on all continents, gathering in the neighborhood of the sea and other large bodies of water, where it dexterously procures the living fish that constitute its food, by plunging from a great height and seizing them in its talons. These gains it is frequently obliged to relinquish to the fish-loving sea-eagles, especially our own bald eagle, which pounces upon the osprey and forces it to drop its property to be caught and swallowed by the robber. Fish-hawks have increased rather than diminished in most of their American haunts where they are protected by law and good-nature, and for the picturesqueness they lend to the landscape. Their nests are huge masses of sticks, placed on a ledge of rocks, or along low shores, in trees, and reoccupied for a long series of years. On the New England coast fish-hawks often make nests in belfries or on platforms set up on stout poles for their accommodation. The eggs are dirty white, marked with irregular purplish and red-brown blotches. This fine hawk (*Pandion haliaëtus*) is about 25 inches long, and has long pointed wings giving it great power and grace in flight. The general color of the upper parts is brown, but the head, neck and all under parts are white, except a band of brown spots across the breast. It stands alone among falconiform birds in a family (*Pandionidæ*) equivalent in rank to the *Falconidæ*, from which it essentially differs in the reversibility of the outer toe; the toes are nearly equal, and have no connecting membrane, but with spicules on their under surfaces and much curved claws enabling the birds to take a firm hold of their slippery prey. A general guide to further information as to the osprey in the Old World may be found in Newton's ‹Dictionary of Ornithology›; and as to the American fish-hawk in Dr. Fisher's ‹Hawks and Owls of the United States.›

Fish-killer, one of the huge heteropterous bugs (q.v.) of the aquatic family *Belostomidæ*, some of which reach a length of four inches, and are able to overcome small fishes. They are oval in outline, dull brown in color, and possess powerful mouth-parts by which they first stab their prey, then seize it and suck its blood. Their legs are flattened, and form powerful paddles, but are also useful for walking; and, supplied by the bubbles of air they take down with them, these big bugs lurk on the muddy bottoms of sluggish waters, ready to rush at and capture their living food. They are highly destructive among the fry in piscicultural ponds, and should be carefully eradicated. They come out of the water in early summer and fly in swarms at night, gathering about lights: and in some places so throng the street-lamps that they have become known as «electric-light bugs.» Consult Howard's ‹Insect Book› (1901); and see FRESH-WATER INSECTS.

Fish-lice, any of many copepod crustaceans, mainly of the group *Siphonostoma*, parasitic on marine animals. All are of small size, often very unlike ordinary *Copepoda* (q.v.) in appearance, and usually transparent. They are born of eggs attached to stones, plants, and the like, and begin life as normal larvæ, but some become parasitic and retrograde: yet some species are able as adults to swim about and change their hosts. These copepods attach themselves to the host by the suckers at the mouth, or by a sucking proboscis, and in some cases, by hooks on the forward swimming-appendages. While generally they confine their attacks to the exterior of the host, some live in the gills of fishes, and others embed themselves in the muscles. *Argulus* is a temporary epizoön. With four pairs of swimming-feet, it moves freely, and is not confined to a single host, entering the gills of a fish, there living for a time, and then enjoying a free life until it is hungry, when it enters another host. *Caligus* is sessile, and attaches itself to the gills of a fish, on whose blood it lives permanently. *Lernea,* and related forms, are wormlike, and anchor in the gills or in the skin of all kinds of fishes, and are sometimes so numerous as finally to cause the death of the host. Not only fishes, but all sorts of marine animals, including whales, are infested by these parasites, which have been extensively studied and reported upon by the United States Fish Commission, whose publication should be consulted.

Fish of Paradise. See PARADISE FISH.

Fish Trap, a box or basket set in a river, and containing bait to attract fish. A basket, net, or staked area with a divergent-sided or funnel-shaped opening through which fish pass, and in which they find a difficulty in retracing their course, owing to obstacles or blind sacs.

Fish'er, Charles, American comedian: b. Suffolk, England, 1816; d. New York 1891. He made his first appearance at the Princess Theatre, London, in 1844, but from 1852 was identified with the American stage, on which he made his début as Ferment in 'The School of Reform.' From 1872 to 1890, when he retired, he was a member of Augustin Daly's company. Best known as Triplet in 'Masks and Faces,' he was also seen as Jacques in 'As You Like It,' and Sir Peter Teazle in 'The School for Scandal.'

Fisher, Clara, American actress: b. London, England, 14 July 1811; d. Metuchen, N. J., 12 Nov. 1898. She made her first appearance on the stage in London when six years old, as Lord Flimnap in 'Gulliver in Lilliput.' Her success at this early age was phenomenal. Later under the direction of her parents she made tours of the United Kingdom, and besides other parts played Norval and Sir Peter Teazle for five years with great financial success. She made her first appearance in the United States as Albina Mandeville in 'The Will' at the Old Park Theatre in New York in 1827. Her success was immediate. Later she visited all of the larger cities of the eastern, southern, and western States. In 1834 she married James Gaspard Maeder, a well-known musician, and settled in Albany, N. Y. She, however, continued on the stage till 1889, when she retired.

Fisher, Frederic Henry, English journalist: b. London, England, 13 April 1849. He has been editor of the 'Literary World' from 1883 and has published: 'Cyprus, Our New Colony, and What We Know About It' (1878); 'Afghanistan and the Central Asian Question.'

Fisher, George Jackson, American physician: b. Westchester County, N. Y., 27 Nov. 1825. He was graduated from the medical department of New York University in 1849; was physician and surgeon at Sing Sing State Prison 1853–4; surgeon to the 7th Brigade, National Guard, State of New York, in 1853–73; and president of the New York Medical Society in 1874. He published 'On Animal Substances Employed as Medicines by the Ancients' (1862); and many other professional monographs.

Fisher, George Park, American educator: b. Wrentham, Mass., 10 Aug. 1847; was graduated at Brown University in 1847; studied theology at the Yale Divinity School, at Andover, and in Germany, was professor of divinity 1854–61, and subsequently of ecclesiastical history at Yale. He is the author of: 'Essays on the Supernatural Origin of Christianity' (1865); 'History of the Reformation' (1873); 'The Beginnings of Christianity' (1877); 'Faith and Rationalism' (1879); 'The Christian Religion' (1882); 'The Grounds of Historic and Christian Belief' (1883); 'Manual of Christian Evidences' (1890); 'Colonial History of the United States' (1892), etc.

Fisher, Irving, American educator: b. Saugerties, N. Y., 27 Feb. 1867. He was graduated at Yale 1888 and took a post-graduate course in Berlin and Paris. He was made instructor in mathematics at Yale 1890, becoming assistant professor of mathematics 1893. He has been professor of political science there from 1895. He has published: 'Mathematical Investigations in the Theory of Value and Prices' (1892); 'Bibliographies of the Present Officers of Yale University' (1893); 'Elements of Geometry,' with A. W. Phillips (1896); 'A Brief Introduction to Infinitesimal Calculus' (1897).

Fisher, John, English prelate: b. Beverley, Yorkshire, 1459; d. London 22 June 1535. In 1501 he was made chancellor of the University of Cambridge, and in 1502 became the first Margaret professor of divinity at Cambridge. In 1504 he was promoted to the see of Rochester. Deeply prepossessed in favor of the ancient faith of the nation, he opposed with zeal and perseverance the principles of Luther and his followers. But the same conscientious motives which induced Fisher to become the champion of Henry VIII., impelled him to oppose the king's measures for procuring a divorce from his wife, and declaring himself head of the Church. In 1527 he was the only prelate who had the courage to refuse to sign a declaration that the marriage of the king was unlawful. He was subsequently sent to the Tower for refusing to submit to the provisions of an act of Parliament which annulled the king's marriage with Catharine of Aragon, and confirmed his subsequent union with Anne Boleyn. Pope Paul III. thought proper to reward his zealous adherent by giving him a cardinal's hat (May 1535). The king exclaimed in a passion, "Mother of God! he shall wear it on his shoulders, for I will leave him never a head to set it on." As no evidence against him existed sufficiently strong to affect his life, Henry employed crafty emissaries to entrap Fisher into a positive denial of the king's supremacy. The plot succeeded, and the bishop was beheaded on Tower Hill. Bishop Fisher was an able theologian, and the author of a commentary on the Seven Penitential Psalms; of sermons, controversial and devotional treatises, etc.; his writings being partly in Latin, partly in English.

Fisher, Joshua Francis, American author: b. Philadelphia, Pa., 1807; d. 1873. He was graduated from Harvard in 1825, was admitted to the bar in 1829, practised in Philadelphia, and was there one of the incorporators of the Pennsylvania Institution for the Instruction of the Blind. His historical studies include: 'The Private Life and Domestic Habits of William Penn' (1836); and 'The Degradation of Our Representative System' (1863).

Fisher, Mary, American educator: b. Marshall County, Ill., 12 April 1858. She is a teacher of French and German in the Kansas City Manual Training High School, and has published: 'Twenty-five Letters on English Authors' (1895); 'A Group of French Critics' (1897); 'A General Survey of American Literature' (1899).

Fisher, Sydney George, American lawyer and historical writer: b. Philadelphia, Pa., 11 Sept. 1856. He was graduated at Trinity College 1879, studying law at Harvard, and being admitted to the bar 1883. His works include: 'The Evolution of the Constitution' (1887); 'The Making of Pennsylvania' (1896); 'Pennsylvania: Colony and Commonwealth' (1897); 'Men, Women, and Manners in Colonial Times' (1898); 'The True Benjamin Franklin' (1899); 'The True William Penn' (1900); 'The True Story of the Revolutionary War' (1902).

Fisher, William Arms, American musician and composer: b. San Francisco, Cal., 27 April 1861. He was a pupil in counterpoint, canon, and fugue of H. W. Parker, in composition of Dvořák, and in singing of William Shakespeare. In 1897 he became an editor for Oliver Ditson & Company, the Boston music-publishers. His compositions number an 'Elegie' for violin and piano, some 40 solo songs, and many part-songs and anthems.

Fisher. Pennant's marten. See MARTEN.

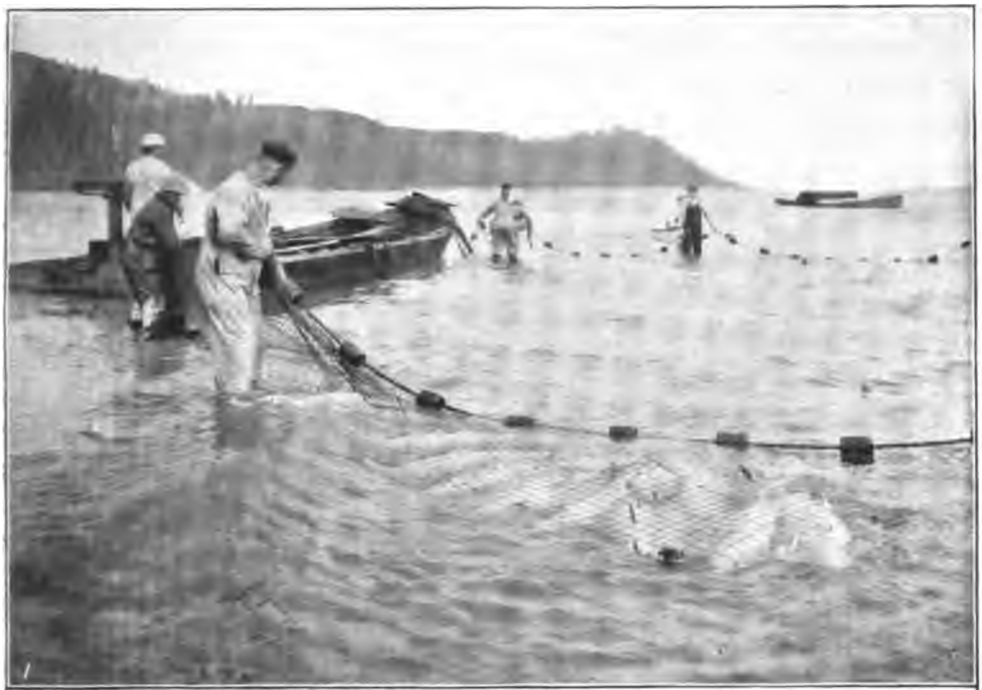
Fisheries, a term which includes the taking of all kinds of water products as a business, and thus applies to the pursuit of whales, seals, otters, and other mammals; to the hunting of frogs, turtles, and alligators; to the taking of oysters, clams, lobsters, crabs, shrimp, and other shellfish; and to the gathering of corals, sponges, and seaweeds, as well as to the capture of fish proper. Closely related to the fisheries are fish culture, by which the supply of water animals is maintained and increased; and the various shore industries having for their object the utilization or preservation of the products as brought in by the fishermen.

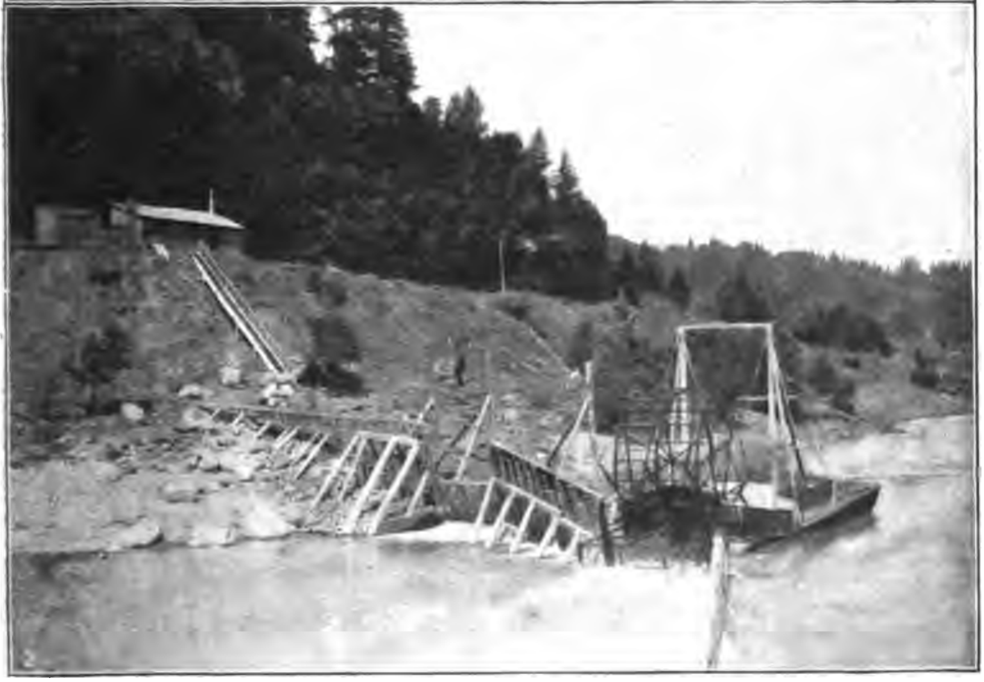
The countries whose fisheries are of greatest commercial importance, being worth upward of $5,000,000 yearly, are the United States, Great Britain, Japan, Russia, France, Canada, Norway, and Newfoundland, in about the order given. Countries which may be regarded as of second-rate importance in this respect, whose fisheries are worth between $1,000,000 and $5,000,000 annually, are Portugal, Spain, Holland, Sweden, Germany and Italy. No data are available for China and India, whose fisheries must be very extensive, and perhaps entitled to rank with those of the leading countries. An estimate based on official data and all other available information gives $300,000,000 as the approximate annual value of the commercial fisheries of the world. Water animals which are of great economic importance in both hemispheres are whales, seals, sea-herring, mackerel, tunny, cod, halibut, lobsters, shrimp, oysters, and sponges. The most valuable of all fishery products are oysters; the most valuable of all fishes are sea-herring, salmon, and cod.

United States.— This is the leading country as regards the aggregate value of its fisheries and the amount of capital invested in the fishing in-

Rank	States	Persons employed	States	Capital invested	States	Value of products
1	Maryland	36,260	Massachusetts	$13,372,902	Alaska	$7,412,456
2	Virginia	29,325	New York	9,865,759	New Jersey	4,755,522
3	Maine	16,954	Washington	6,601,243	Virginia	4,613,384
4	Massachusetts	14,363	Maryland	6,506,066	Massachusetts	4,463,727
5	New York	13,474	Alaska	6,137,737	New York	4,196,272
6	North Carolina	12,045	Maine	4,01[illegible],053	Maryland	3,767,461
7	New Jersey	12,030	Virginia	3,637,104	Washington	2,871,438
8	Washington	9,911	Oregon	3,497,643	Maine	2,654,919
9	Alaska	8,680	California	2,780,186	California	2,559,993
10	Florida	6,143	New Jersey	2,729,571	Connecticut	1,559,599
11	Oregon	5,643	Pennsylvania	2,567,364	North Carolina	1,316,017
12	Louisiana	4,933	Illinois	2,096,665	Florida	1,080,870
13	California	4,042	Ohio	1,889,971	Rhode Island	955,058
14	Michigan	3,427	Florida	1,300,417	Michigan	894,060
15	Mississippi	3,105	Michigan	1,287,448	Oregon	855,750
16	Illinois	3,074	Connecticut	1,241,291	Louisiana	784,144
17	Pennsylvania	2,948	North Carolina	1,218,459	Ohio	743,043
18	Iowa	2,637	Rhode Island	957,142	Illinois	616,452
19	Ohio	2,563	Delaware	657,197	Wisconsin	542,304
20	Connecticut	2,473	Wisconsin	657,164	Pennsylvania	527,378
21	South Carolina	2,139	Missouri	645,671	Texas	302,763
22	Delaware	1,998	Mississippi	561,672	Mississippi	290,009
23	Wisconsin	1,919	Louisiana	537,532	Alabama	237,931
24	Georgia	1,869	Iowa	341,669	Missouri	211,301
25	Rhode Island	1,687	Georgia	284,864	South Carolina	210,456
26	Missouri	1,531	Texas	240,112	Iowa	207,801
27	Texas	1,372	Minnesota	222,633	Delaware	203,372
28	Alabama	1,197	Alabama	179,520	Georgia	170,605
29	Minnesota	783	South Carolina	174,354	Arkansas	168,071
30	Indiana	610	Nebraska	122,884	Tennessee	87,537
31	Kentucky	589	Tennessee	92,883	Minnesota	87,405
32	Utah	505	Kentucky	87,286	Indiana	86,129
33	Tennessee	476	Indiana	55,175	Kentucky	78,899
34	Arkansas	463	Utah	52,985	New Hampshire	48,987
35	Nebraska	196	New Hampshire	52,648	Utah	47,458
36	Vermont	169	Arkansas	39,105	Nebraska	15,937
37	New Hampshire	154	Vermont	4,794	South Dakota	14,850
38	Nevada	120	Kansas	3,836	Kansas	13,546
39	Kansas	118	West Virginia	3,591	Nevada	12,834
40	South Dakota	115	South Dakota	2,974	West Virginia	12,112
41	West Virginia	86	Idaho	2,375	Idaho	11,929
42	Idaho	57	Nevada	1,905	Vermont	7,160
	Total	212,183	Total	$76,720,850	Total	$49,696,939

FISHERIES.





1. **Seining for** salmon on the Columbia river. 2. Fish wheel at Cascades, Columbia river.

dustry, and it also takes first rank in the yield of a number of special products common to many countries. The importance attained by the United States fisheries has been due to the abundance, variety, excellence, and wide distribution of the products, augmented by cultivation and acclimatization. The abundance of food fishes had a marked influence on the original colonization of the country, and was also an important factor in the subsequent development of various regions. At the outbreak of the Revolutionary War, some of the vessel fisheries had already become very extensive, and sailor-fishermen, mostly from New England, manned our naval vessels and privateers and rendered valiant service.

The number of persons who are regularly engaged in the fishing industry is approximately 212,000, of whom 154,000 are sea fishermen and 58,000 shoresmen, preparators, factory hands, etc. The aggregate number of people dependent on the fisheries is upward of 1,000,000, or about one eightieth of the entire population. The capital invested in the fisheries is about $76,720,850, of which $13,456,050 represents vessels, $4,530,600 boats, $8,215,330 apparatus and appliances, and $50,518,835 shore property and cash capital. The number of fishing vessels is 6,337, tonnage 172,377, and the number of open boats and vessels under five tons' burden is 79,216. The yield of the United States fisheries fluctuates considerably, but of late has averaged about $45,000,000. The statistics herewith presented, which embody the latest returns for the different regions, give a total catch of $49,696,900, a sum representing the value of the fish as first put on the market. The approximate aggregate weight of the output is 1,916,427,600 pounds, including only the soft parts of products like oysters, clams, scallops, etc.

Following is a summary showing the rank of the different States as regards persons employed, capital invested, and value of products. The years to which the figures in this and the following tables relate are, for the New England States; for the Middle Atlantic States; for the South Atlantic and Gulf States; for the Pacific States, Great Lakes, and interior waters, and for Alaska. The statistics have been supplied by the Bureau of Fisheries, Department of Commerce and Labor of the United States.

A characteristic feature of the New England fisheries is the employment of a large fleet of fine schooner-rigged vessels in the offshore fisheries for cod, haddock, hake, halibut, and mackerel. Cod is the principal fish so taken, part of the catch being made on the Grand Banks and other banks lying off Newfoundland and Nova Scotia, and part on the very extensive and prolific banks adjacent to the New England shore, the most noted of which is Georges Bank. The most important of the New England boat and shore fisheries are those for sea-herring (caught chiefly in brush weirs), lobsters (caught in pots made of laths), soft-shell clams, and oysters. In the catch of herring, soft-shell clams, and lobsters, Maine surpasses all other States.

The oyster industry of the Middle Atlantic States gives to that region the importance which its fisheries have attained. The principal oyster grounds are in Long Island Sound, Delaware Bay, and Chesapeake Bay, a large part of the output now being taken from planted beds. An immense fleet of sailing vessels and boats is engaged in dredging and tonging oysters and running them to market. Other important salt-water products of this section are blue-fish, menhaden, sea bass, squeteague, hard clams, and crabs. The anadromous fishes, the shad, the alewives, and the striped bass, support valuable fisheries. The South Atlantic region has no noteworthy vessel fisheries, but its pound-net, gill-net, and seine fisheries for alewives, shad, sea mullet, and squeteague are important, shad being the leading product. The most prominent products of the Gulf States are mullet, red snappers, squeteague, oysters, shrimp, and sponges.

The Pacific States have very important vessel fisheries addressed to cod, halibut, and whales, and very extensive shore fisheries for salmon, herring, and oysters. The salmon fishery is the most valuable in the world, immense quantities of quinnat, blue-back, silver, and other salmon being caught in the Sacramento and Columbia rivers, in Puget Sound, and in Alaska. Much of the yield is canned. The salmon output exceeds 248 million pounds.

The fisheries of the Great Lakes are the most important lake fisheries in the world, those in the United States waters producing over 100,000,000 pounds of excellent food fish annually. Lake Erie has the largest catch, closely followed by Lake Michigan. The principal fishes are whitefish, lake herring or cisco, lake trout, pike perch, and yellow perch. The numerous interior waters of the country are well supplied with economic animals and support valuable fisheries. The most productive waters are the Mississippi River and tributaries. The species figuring most conspicuously in the catch are black bass, buffalo-fish, carp, crappies, suckers, frogs, and mussels, the shells of the last named being extensively used in making pearl buttons.

The table on the following page shows the extent of the fisheries in each of the foregoing geographical divisions:

The products of the United States fisheries may be classified as follows.

PRODUCTS	Value
Food-fishes in general..............	$27,889,588
Menhaden (for oil and guano)......	973,260
Whales, seals, and other mammals..	1,321,247
Turtles, terrapin, alligators, frogs...	254,922
Oysters and other mollusks.........	16,700,524
Lobsters and other crustaceans......	2,251,869
Sponges	305,589
Total	$49,696,939

United States Insular Possessions.—The fisheries of Hawaii give employment to about 2,400 people, of whom 1,600 are natives, 500 Japanese, and 240 Chinese. The value of fishing property is $300,000. The catch comprises 6,250,000 pounds of fish and other products, mostly eaten fresh, and is valued at $1,100,000. The Philippine Islands have valuable fishing resources which are but little developed. The leading fishery is that for pearls and pearl shells in the Sulu archipelago; from time immemorial the pearls from this region have been famous. No statistics are available. The fisheries of Porto Rico are comparatively unimportant, although capable of development; at present the catch is only for local consumption and is eaten fresh.

Canada.—The fisheries of the Dominion of Canada are very extensive and closely resemble those of the United States. The aggregate yield

FISHERIES OF THE UNITED STATES ACCORDING TO GEOGRAPHICAL SECTIONS.

SECTIONS	Persons employed			Vessels				Boats		Apparatus of capture	Shore property	Cash capital	Total investment	Products	
	Fisher-men	Shores-men	Total	No.	Net tonnage	Value	Outfit	No.	Value					Lbs.	Value
New England States...	22,367	13,264	35,631	1,427	43,821	$2,920,825	$1,303,514	10,557	$ 621,670	$1,218,898	$7,115,030	$6,457,099	$19,637,036	393,457,906	$ 9,682,290
Middle Atlantic States..	70,923	22,738	93,661	3,721	54,761	3,657,103	1,088,706	36,237	2,024,980	1,713,454	9,561,356	7,035,872	25,081,471	819,046,576	17,485,500
South Atlantic States..	14,449	2,736	17,185	243	2,791	158,350	41,830	6,691	276,866	492,696	531,290	327,800	1,828,832	80,390,465	1,833,155
Gulf States............	11,180	2,787	13,967	425	5,053	464,343	252,733	6,025	436,041	137,216	579,578	714,150	2,584,061	65,660,623	2,271,726
Pacific States...........	16,065	12,143	28,208	309	62,297	1,942,440	803,361	7,059	744,850	2,870,031	4,695,690	7,954,744	19,011,116	340,515,386	13,691,095
Great Lakes	7,905	1,765	9,670	208	3,541	659,650	142,971	3,281	227,766	1,428,226	2,225,503	1,933,600	6,617,716	113,727,240	2,611,439
Interior Waters........	11,180	2,681	13,861	4	113	18,000	2,225	9,366	198,462	354,808	788,923	598,200	1,960,618	103,629,404	2,121,734
Total	154,069	58,114	212,183	6,337	172,377	$9,820,711	$3,635,340	79,216	$4,530,635	$8,215,329	$25,497,370	$25,021,465	$76,720,850	1,916,427,600	$49,696,939

according to official report, is annually about $26,000,000, which includes the value of canned products and hence exceeds by several million dollars the actual value of the fisheries proper. The number of persons engaged in 1910 was about 95,000, and the capital invested about $11,500,000. The fisheries of Nova Scotia are more extensive than those of the other provinces; here cod, haddock, herring, mackerel, and lobsters are taken in large quantities. New Brunswick and Quebec have fisheries similar to those of Nova Scotia, while Ontario and Manitoba have important fresh-water fisheries for whitefish, trout, and other lake species. The fisheries of British Columbia, which rank next to those of Nova Scotia, are addressed chiefly to salmon. The principal catch is in the Fraser River. See CANADA — FISHERIES.

Newfoundland.— In proportion to population, the fisheries of this island are more valuable than those of any other country. The value of fishery products exported is about $8,000,000, and the value of products consumed locally was estimated at $1,000,000. The leading fish are cod and herring, the cod fishery being more valuable than in any other country. The hair-seal fishery is another branch in which Newfoundland leads.

Great Britain and Ireland.—The fisheries of the British Isles surpass those of any other country of Europe, and are about equal to those of the United States. Besides extensive coast fisheries, there are very important offshore vessel fisheries for cod, haddock, herring, and flatfishes, gill-nets being set for herring and beam trawls used for the other species. About 106,500 persons find employment in fishing, of which 39,500 are in England and Wales, 37,400 in Scotland, and 28,000 in Ireland. The registered fishing vessels and boats numbered 25,000. The fisheries of England and Wales are valued at about $33,300,000; Scotland, $11,250,000; Ireland, $1,813,900 — a total of about $46,500,000.

Russia.— This country has vast fishery resources, and the annual catch exceeds in value that of any other country of Europe except Great Britain. The ocean fisheries are insignificant, but those of the Caspian Sea and the fresh waters, especially the Ural and Volga rivers, are very highly developed. The herring fisheries of the Caspian Sea are famous, and millions of pounds are caught annually. The sturgeon and the pike perch fisheries are the most valuable in the world. The roach is so abundant and cheap that it may be considered the national fish; between 200,000,000 and 300,000,000 pounds are taken annually in the Caspian Sea. Other important products are carp, catfish, bream, whitefish, yellow perch, and lampreys. Accurate statistics are lacking, but a Russian official estimate gives an annual catch of 1,500,000,000 pounds, valued at $25,000,000.

France.— Fisheries of great magnitude are prosecuted in the coast waters of France and by French fishermen in Newfoundland, Iceland, and the North Sea. The number of vessel and boat fishermen is about 97,000 and of shore fishermen 62,000; and the value of the products taken was $21,240,000. In the cod fisheries of Newfoundland, Iceland, and the North Sea, 44,600,000 kilograms of fish, valued at $3,800,000 were caught; and in the high-sea fisheries 56,300,000 kilograms of herring, mackerel, and other fish, valued at $5,600,000, were taken. The principal coast fishery is that for sardines, large quantities of which are canned and sent to all parts of the world; the quantity taken was about 40,200,000 kilograms, worth $2,400,000. Other valuable products are tunny, lobsters, spiny lobsters, crayfish, oysters, mussels and seaweeds. The cultivation of oysters has reached great perfection and upward of 1,000,000,000 oysters, grown in artificial enclosures, are marketed annually.

Norway.—More than 120,000 people are employed in the Norwegian fisheries. The principal products are cod, valued at about $3,660,000; herring, valued at $2,440,000; and salmon and trout, valued at $280,000. The cod fishery is carried on chiefly at the Lofoten Islands, where 35,000 fishermen are engaged. Other important fisheries are the lobster, whale, seal, and shark. The total value of the fisheries was about $7,900,000. A large part of the catch is exported to other European countries and the United States.

Other European Countries.—Germany has cod and herring fisheries, in the Baltic and North seas, and minor fresh-water fisheries. Upward of 32,000 persons are reported to be employed, and the annual catch is worth several million dollars, but definite statistics are not available. The Netherlands have valuable herring fisheries, which yield about $1,478,000. Other valuable products are cod, anchovy, and oysters. The yearly production is valued at about $2,000,000. The fisheries of Denmark are valued at about $1,995,000. The fishermen of Belgium catch chiefly herring and cod, the output being about $1,250,000 annually. Portugal has 4,000 vessels and boats, mostly engaged in the sardine and tunny fisheries; the products taken have a value of about $4,182,000. The fisheries of Spain are estimated to be worth $2,500,000, but no definite information regarding them is obtainable. Italy has nearly 100,000 fishermen engaged in the tunny, coral, sponge, and general food-fish fisheries. The aggregate value of water products is estimated at $3,500,000 yearly. The Swedish fisheries are valued at about $2,056,000. The principal species sought is the herring; the herring fishery of Bohuslän is famous, employing 7,500 men. Other important products are cod, mackerel, eels, salmon, and lobsters. The sea fisheries of Austria-Hungary give employment to about 15,300 persons, and yield $1,405,000 worth of fish, etc. Greece and Turkey have valuable sponge fisheries.

Japan.—The fisheries of Japan are in some respects the most important in the world, and in value rank next to those of the United States and Great Britain. While complete statistics are lacking, it is known that about 400,000 vessels and boats are employed and that about 2,508,000 persons are engaged in fishing. All the coast waters abound in excellent food fishes, mollusks, crustaceans, and other products, together with many objects used for ornamental, artistic, and other purposes beside for food. The leading products are sardines (of which 500,000,000 pounds are annually caught), herring, tai, bonito, mackerel, tunny, salmon, cod, squid, coral, and algæ. The herring, salmon, cod, and other fisheries of Hokkaido, the most northern of the main islands, are very extensive, yielding nearly 1,000,000,000 pounds. The aggregate output of the Japanese fisheries is probably not less than 2,000,000,000 pounds a year, with an estimated value of $30,000,000. It is probably in excess of this.

Bibliography.—Goode, ‘Fishery Industries of the United States’ (7 vols. 4to, 1884-7); Simmonds, ‘Commercial Products of the Sea’ (1883); McIntosh, ‘Resources of the Sea’ (1899); Faber, ‘The Fisheries of the Adriatic’ (1883); Annual Reports and Bulletins of the United States Fish Commission; Annual Government Reports on the Fisheries of Canada, Great Britain, and Ireland, etc.; France, ‘Statistique des Pêches Maritimes’ (annual).

Fisheries Question. The provinces of British North America in 1760-76 enjoyed mutual fishing rights on the entire North Atlantic coast, but when the Revolution severed Canada from the rest of the seaboard, Great Britain proposed to deny the United States the right to fish there, on the ground of Canadian opposition. As this meant ruin to a great New England industry, the Canadian waters being the cream of the fishing grounds, John Adams refused to sign the Treaty of Paris (7 Sept. 1783) until the right was granted, though his fellow commissioners would have sacrificed them; and his stubbornness secured their retention. Fishing could still go on; but we could not dry or cure fish on the coast of Newfoundland, or the settled coasts or river-banks of Nova Scotia, the Magdalen Islands, or Labrador, except by agreement with the inhabitants. Under these provisions, the energetic American fishermen occupied many excellent fishing stations along the Canada shore; to the envy and dissatisfaction of the British; and when the War of 1812 broke out, the latter seized the opportunity to declare the Treaty of Paris abrogated, and order the Canadian officials to refuse American fishermen access to the grounds. The Americans declared the fishery provisions of the Treaty unvoidable. The Treaty of Ghent, of 1814, ignored this question, as it did so much else of vital import, and the old rights were tacitly allowed to stand. But in 1818 a joint convention at London revised the fishing provisions: the United States were to have the right only of fishing in the deep sea at least three miles from shore, except on the western and northern coast of Newfoundland and the Magdalens; but could dry and cure on the coasts as before, and enter bays and harbors for wood or water or for refuge. But the three-mile provision was the bone of contention it has always been, as to headlands, etc., and here as to the Gut of Canso — in effect, the American right to fish in the Gulf of St. Lawrence, Chaleurs Bay, or the Bay of Fundy; as to the latter, an American vessel was seized for fishing in it, and on arbitration the American claim was held valid. Finally, the Reciprocity Treaty of 1854 abolished all mutual restrictions on deep-sea fishing except for shellfish. The United States abrogated this treaty in 1866, and conditions reverted to those of 1818, but the Treaty of Washington in 1871, to take effect in 1873, revived it again in full down to lat. 39° N. The Canadians, however, asserted that their waters were much the more valuable, and on arbitration provided for in the treaty, they were awarded $5,500,000 in 1877, on a claim of $14,280,000. In 1885 the United States again abrogated reciprocity, under pressure from fishing interests, and returned to the 1818 status with its disputed meanings. Our fishing vessels were seized as before; and in 1887 Congress authorized the President at his discretion to lay an embargo on all Canadian commerce to American ports, which, however, has not been done. In 1888 the Chamberlain-Bayard Treaty arranged these difficulties, but the Senate rejected it; in 1890, however, the Canadian government embodied it in its laws. A joint high commission to settle the question met in Washington in 1899, but adjourned without coming to a decision. In all cases, however, the provisions of the Convention of London, 1818, is held by both governments as binding in absence of special treaties overriding them. The crucial point has always been and is likely to be the "headland doctrine." The Americans claim that it should not be recognized, but the curves of the coast followed instead of drawing the line from headland to headland; the Canadians say it is vital to the protection of their own fishermen.

Fisher's Hill, about 20 miles south of Winchester, Va., between the Massanutten and North Mountains, and with its base washed by a branch of the Shenandoah. This place was the scene of an action, 22 Sept. 1864, between a National force under Gen. Sheridan, and one of Confederates commanded by Gen. Early.

Fisher's Hill, Battle of. Gen. Early was defeated at the battle of the Opequon, Va., 19 Sept. 1864, and retreated during the night, 20 miles up the Shenandoah Valley to Fisher's Hill, two miles south of Strasburg, Va. Gen. Sheridan followed at daylight of the 20th up the Valley pike, Gen. Wilson's cavalry division covering his left and Gen. Averell's division on his right. During the afternoon of the 20th Wright's Sixth corps and Emory's Nineteenth corps arrived at Cedar Creek, crossed and took position on the heights fronting Strasburg. Crook's Eighth corps halted on the left bank of the creek. On 21 Sept. Sheridan pushed through the town, drove Early's skirmishers to the entrenchments and reconnoitered the position, which, naturally strong, Early had strengthened with works of earth and stone, behind which was Wharton's division on the right, then Gordon's, Pegram's, and Ramseur's, with Lomax's division of dismounted cavalry on the extreme left. Fitz Hugh Lee's cavalry was at Millford, 12 miles above Front Royal, guarding Luray Valley and Early's right. Sheridan ordered Gen. Torbert, with Merritt's and Wilson's cavalry divisions, to the Luray Valley to drive out any force of the enemy in that quarter, and cross over from the valley to New Market, and intercept Early's retreat. During the afternoon the Sixth corps, after a serious repulse, succeeded in gaining a commanding position near the Confederate works, which was immediately entrenched and artillery put in position. Early's right was too strongly posted to attack in front, so Sheridan concluded to turn and attack his left. During the night of the 21st Crook crossed Cedar Creek and, hidden in a clump of timber, remained until daylight, when, under cover of woods and ravines, he marched in rear of and beyond the right of the Sixth corps, and was again concealed, while Rickett's division of the Sixth corps was pushed out and confronted the left of Early's infantry, ready to join Crook's left when he should attack. While Rickett's was threatening in front Crook marched unobserved into the dense timber on the eastern face of Little North Mountain, until he gained the rear of Early's works when, facing to the left, he marched down the mountain side, at sunset. He was seen by Lomax, artillery was turned upon him, but too late; he struck Lomax's dismounted men in flank and rear, driving them back on Ramseur, who endeavored to change front, but Rickett's division advancing struck Ramseur in the act, joined Crook's left, and the two commands moved along in rear of Early's entrenchments, his men giving way all along the line, abandoning many guns. The swinging movement of Rickett's division on the right was taken up from right to left, and between sunset and darkness Early's entire army was defeated and in disorderly retreat. Early reported next morning to Gen. Lee that the enemy "succeeded in driving back the left of my line which was defended by the cavalry, and throwing a force in the rear of the left of my infantry, when the whole of the troops gave way in a panic and could not be rallied." Early retreated four miles beyond Woodstock and Sheridan pursued him all night, to Woodstock, 12 miles, which was reached at daybreak next morning. The Union loss was 509 killed and wounded. Early reported a loss in infantry and artillery of 240 killed and wounded and 995 missing. The loss in Lomax's cavalry would swell the entire Confederate loss to about 1,400.

Consult: 'Battles and Leaders of the Civil War,' Vol. IV.; 'Official Records,' Vol. XLII.; Pond, 'The Shenandoah Valley in 1864'; Sheridan, 'Personal Memoirs.'

E. A. Carman.

Fisher's Island, at the entrance of Long Island Sound, near Connecticut. The island is in the State of New York; it is a part of the Southold township, in Suffolk County, N. Y. Area 4,000 acres.

Fishes, Geographical Distribution of. The laws governing the distribution of animals are reducible to three very simple propositions. Each species of animal is found in every part of the earth having conditions suitable for its maintenance, unless:

(*a*) Its individuals have been unable to reach this region through barriers of some sort; or,

(*b*) Having reached it, the species is unable to maintain itself, through lack of capacity for adaptation, through severity of competition with other forms, or through destructive conditions of environment; or else,

(*c*) Having entered and maintained itself, it has become so altered in the process of adaptation as to become a species distinct from the original type.

Under the first head, numerous illustrations may be given. The absence of loaches in America and of mooneyes in Europe may serve as examples.

Of species under (*b*), those who have crossed the seas and not found lodgment, there is, in the nature of things, no record. Of the existence of multitudes of estrays there is abundant evidence. Now and then one among thousands finds permanent lodgment, and by such means a species from another region will be added to the fauna. The rest disappear and leave no trace. A knowledge of the currents of the sea and their influence is essential to any detailed study of the dispersion of fishes.

In the third class, that of species changed in the process of adaptation, most insular forms belong. As a matter of fact, at some time or another almost every species must be in this category, for isolation is a source of the most potent elements in the initiation and intensification of the minor differences which separate related species. It is not the preservation of the most useful features, but of those which actually existed in the ancestral individuals, which distinguished such species. In many cases the persistence of characters rests not on any special usefulness or fitness, but on the fact that individuals possessing these characters have, at one time or another, invaded a certain area and populated it.

Barriers Checking Movement of Fishes.—The limits of the distribution of individual species or genera must be found in some sort of barrier, past or present. The chief barriers which limit marine fishes are the presence of land, the presence of great oceans, the differences of temperature arising from differences in latitude, the nature of the sea-bottom, and the direction of oceanic currents. That which is a barrier to one species may be an agent in distribution to another. The common shore-fishes would perish in deep waters almost as surely as on land, while the open Pacific is a broad highway to the albacore or the swordfish.

Again, that which is a barrier to rapid distribution may become an agent in the slow extension of the range of a species. The vast continent of Asia is undoubtedly one of the greatest of barriers to the wide movement of species of fish, yet its long shore-line enables species to creep, as it were, from bay to bay, or from rock to rock; till, in many cases, the same species is found in the Red Sea and in the tide-pools or sand-reaches of Japan, or even in the brooks or coral pools of Tahiti or Samoa. In the North Pacific the presence of a range of half-submerged volcanoes, known as the Aleutian and the Kurile Islands, has greatly aided the slow movement of the fishes of the tide-pools and the kelp. To a school of mackerel or of flying-fishes these rough islands might form an insuperable barrier.

Temperature the Central Fact.—It has long been recognized that the matter of temperature is the central fact in all problems of geographical distribution. Few species in any group freely cross the frost-line, and except as borne by oceanic currents, few species extend their range far into waters colder than those in which the species is distinctively at home. Knowing the average temperature of the water in a given region, we know in general the types of fishes which must inhabit it. It is the similarity in temperature and physical conditions, not the former absence of barriers, which chiefly explains the analogy of the Japanese fauna to that of the Mediterranean or the Antilles. This fact alone must explain the resemblance of the Arctic and Antarctic faunæ. Like forms lodge in like place.

Ocean Currents.—We may consider again for a moment the movements of the great currents in the Pacific as agencies in the distribution of species.

A great current sets to the eastward, crossing the ocean just south of the tropic of Cancer. It extends between the Gilbert and the Marshall islands and passes on nearly to the coast of Mexico, touching the Galapagos Islands, Clipperton Island, and especially the Revillagigedos. This may account for the number of Polynesian species found on these islands, about which they are freely mixed with immigrants from the mainland of Mexico.

From the Revillagigedos the current moves northward, passing the Hawaiian Islands and thence onward to the Ladrones. The absence in Hawaii of many of the characteristic fishes of the Samoan Islands and the Gilbert Islands is perhaps due to the long detour made by these currents, as the conditions of life in these groups of islands are not very different. Northeast of Hawaii is a great spiral current, moving with the hands of the watch, forming what is called Fleurieu's Whirlpool. This does not reach the coast of California. This fact may account for the almost complete distinction in the shore-fishes of Hawaii and California.

It is, of course, not necessary that the movements of a species in an oceanic current should coincide with the direction of the current. Young fishes, or fresh-water fishes, would be borne along with the water. Those that dwell within floating bodies of seaweed would go whither the waters carry the drifting mass. But free-swimming fishes, as the mackerel or flying-fishes, might as readily choose the reverse direction. To a free-swimming fish, the temperature of the water would be the only consideration. It is thus evident that a current which to certain forms would prove a barrier to distribution, to others would be a mere convenience in movement.

Centres of Distribution.—We may assume, in regard to any species, that it has had its origin in or near that region in which it is most abundant and characteristic. Such an assumption must involve a certain percentage of error or of doubt, but in considering the mass of species, it would represent essential truth. In the same fashion, we may regard a genus as being autochthonous or first developed in the region where it shows the greatest range or variety of species. Those regions where the greatest number of genera are thus autochthonous may be regarded as centres of distribution. So far as the marine fishes are concerned, the most important of these centres are found in the Pacific Ocean. First of these in importance is the East Indian Archipelago, with the neighboring shores of India. Next would come the Arctic Pacific and its bounding islands, from Japan to British Columbia. Third in importance in this regard is Australia. Important centres are also found in temperate Japan, in California, the Panama region, and in New Zealand, Chile, and Patagonia. The fauna of Polynesia is almost entirely derived from the East Indies; and the shore fauna of the Red Sea, the Bay of Bengal and Madagascar, so far as genera are concerned, seems to be not really separable from the Indian fauna generally.

In the Atlantic the chief centre of distribution is the West Indies; the second is the Mediterranean. On the shores to the northward or southward of these regions occasional genera have found their origin. This is true especially of the New England region, the North Sea, the Gulf of Guinea, and the coast of Argentina. The fish-fauna of the North Atlantic is derived mainly from the North Pacific, the differences lying mainly in the lower richness of the North Atlantic. But, in certain groups common to the two regions, the migration must have been in the opposite direction; exceptions that prove the rule.

Realms of Fresh-Water Distribution.—If we consider the fresh-water fishes alone we may divide the land areas of the earth into districts and zones, fairly agreeing with those marked out for mammals and birds. The river-basin, bounded by its water-sheds and the sea at its mouth, shows many resemblances, from the point of view of a fish, to an island considered as the home of an animal. It is evident that with fishes the differences in latitude outweigh those of continental areas, and a primary division into Old World and New World would not be tenable.

The chief areas of dispersion of fresh-water fishes may be indicated as below, following essentially the grouping proposed by Dr. Günther.

Northern Zone (Arctic and Temperate): With Dr. Günther, we may recognize, first the Northern Zone characterized familiarly by the presence of sturgeon, salmon, trout, whitefish, pike, lamprey, stickleback, and other species of which the genera and often the species are identical in Europe, Siberia, Canada, Alaska, and most of the United States, Japan, and China.

Equatorial Zone: The Equatorial Zone is roughly indicated by the tropics of Cancer and Capricorn. Its essential feature is that of the temperature, and the peculiarities of its divisions are caused by barriers of sea or mountains.

Dr. Günther finds the best line of separation into two divisions to lie in the presence or absence of the great group of dace or minnows, (*Cyprinidæ*), to which nearly half of the species of fresh-water fishes the world over belong. The entire group, now spread everywhere except in the Arctic, South America, Australia, and the islands of the Pacific, had its origin in India, from which its genera have radiated in every direction.

The Cyprinoid division of the Equatorial Zone forms two districts, the Indian and the African. The Acyprinoid division includes South America, south of Mexico, and all the islands of the tropical Pacific lying to the east of Wallace's line. This line, separating Borneo from Celebes and Bali from Lompoe, marks in the Pacific the western limit of cyprinoid fishes, as well as that of monkeys and other important groups of land animals. This line, recognized as very important in the distribution of land animals, coincides in general with the ocean current between Celebes and Papua, which is one of the sources of the Kuroshiwo.

Southern Zone: The third great region, the Southern Zone, is scantily supplied with fresh-water fishes, and the few it possesses are chiefly derived from modifications of the marine fauna or from the Equatorial Zone to the north. Three districts are recognized, Tasmanian, the New Zealand and the Patagonian.

Faunal Resemblances.—There are two main sources of faunal resemblances; first, the absence of barriers permitting the actual mingling of the species; second, the likeness of temperature and shore configuration favoring the lodgment or development of the same or analogous types. If the fish-faunas of different regions have mingled in recent times the fact would be shown by the presence of the same species in each region. If the union were of remote date the species would be changed, but the genera might remain identical.

In case of close physical resemblances in different regions, as in the East Indies and West Indies, like conditions would favor the lodgment of like types, but the resemblance would be general, the genera and species being unlike. Without doubt part of the resemblance between Japan and the Mediterranean is due to similarity of temperature and shores.

Direction of Shore-Line.—We may first note that a continuous shore-line produces a mingling of fish-faunas only when not interrupted by barriers due to climate. A north and south coast-line, like that of the East Pacific, however unbroken, permits great faunal differences. It is crossed by the different zones of temperature. An east and a west shore-line lie in the same temperature. In all cases of the kind which now exist on the earth (the Mediterranean, the Gulf of Mexico, the Caribbean Sea, the shores of India), most species will extend their range as far as the shore-line goes. The obvious reason is because such a shore-line rarely offers any important barrier to distribution, checking dispersion of species.

Genera in Different Faunas.—For our purposes, the genera must be rigidly defined, a separate name being used in case of each definable difference in structure. The wide-ranging genera of the earlier systematists were practically cosmopolitan, and their distribution teaches us little. Using the modern definition of genus, we find in Japan 483 genera of marine shore-fishes; in the Red Sea, 225; in the Mediterranean, 231. In New Zealand 150 are recorded; in Hawaii, 171; 357 from the West Indies, 187 from the Pacific coast of tropical America, 300 from India, 450 from the East-Indian islands and 427 from Australia.

Of the 483 genera ascribed to Japan 156 are common to the Mediterranean also, 188 to the West Indies and Japan, 169 to the Pacific coast of the United States and Mexico. With Hawaii Japan shares 90 genera, with New Zealand 62; 204 are common to Japan and India, 148 to Japan and the Red Sea, most of these being found in India also; while 200 genera are common to Japan and Australia.

From this, it is evident that Japan and the Mediterranean have much in common, but apparently not more than Japan shares with other tropical regions. Japan naturally shows most likeness to India, and next to this to the Red Sea. Proportionately less is the resemblance to Australia, and the likeness to the Mediterranean seems much the same as that to the West Indies, or to the Pacific coast of America. But, to make these comparisons just and effective, we should consider not the fish-fauna as a whole; we should limit our discussions solely to the forms of equatorial origin. We should eliminate all pelagic and all deep-sea forms, for the laws which govern the distribution of these are very different from those controlling the shore-fishes, and most of the genera have reached a kind of equilibrium over the world. We may note also, as a source of confusion in our investigation, that numerous forms found in Japan and elsewhere are very rarely taken, and their real distribution is unknown. Some of these will be found to have, in some unexpected quarter, their real centre of dispersion. Such species may inhabit oceanic plateaus, and find many halting places in their circuit of the tropical oceans.

Extension of Indian Fauna.—From statistical tables representing the distribution of genera it is evident that the warm-water fauna of Japan, as well as that of Hawaii, is derived from the great body of the fauna of the East Indies and Hindustan; that the fauna of the Red Sea is derived in the same way; that the fauna of the Mediterranean bears no especial resemblance to that of Japan, rather than to other elements of the East Asiatic fauna in similar conditions of temperature, and no greater than is borne by either to the West Indies; that the faunas of the sides of the Isthmus of Suez have relatively little in common, while those of the two sides of the Isthmus of Panama show large identity of genera, although few species are common to the two sides. Of the 255 genera recorded from the Panama region 179, or over 70 per cent, are also in the West Indies; while 68, or more than 30 per cent of the number, are limited to the two regions in question.

The Isthmus of Suez as a Barrier.—With free connection across the Isthmus of Suez, the fauna of the Red Sea must have been once practically the same as that of the Mediterranean. The present differences must be due to later immigrations to one or the other region, or to the extinction of species in one locality or the other, through some kind of unfitness. In neither region is there evidence of extensive immigration from the outside. The present conditions of water and temperature differ a little, but not enough to explain the difference in faunas. The Red Sea is frankly tropical and its fauna is essentially Indian, much the same, so far as genera are concerned, as that of southern Japan. The Mediterranean is at most not more than semi-tropical, and its fishes are characteristically European. Its tropical forms belong rather to Guinea than to the East Indies. With the Red Sea the Mediterranean has very little in common, not so much, for example, as has Hawaii, much less than has Samoa. Forty genera of shore-fishes (and only 50 of all fishes) are identical in the two regions, the Mediterranean and the Red Sea. Of those, every one is a genus of wide distribution, found in nearly all warm seas. Of shore-fishes, only one genus in seven is common to the two regions. Apparently, therefore, we cannot assume a passage across the Isthmus of Suez within the lifetime of the present genera. Not one of the types alleged to be peculiar to Japan and the Mediterranean is thus far known in the Red Sea. Scarcely any of the characteristically abundant Mediterranean types crosses the Isthmus of Suez, and the distinctive Red Sea and Indian types are equally wanting in the Mediterranean. The only genera which could have crossed the Isthmus are certain shallow-water or brackish-water forms, sting-rays, torpedoes, sardines, eels, and mullets, widely diffused through the East Indies and found also in the Mediterranean. The former channel, if one ever existed, had therefore much the same value in distribution of species as the present Suez Canal.

Submersion of the Isthmus of Suez.—Yet, from geological data, there is strong evidence that the Isthmus of Suez was submerged in relatively recent times. The recognized geological maps of the isthmus show that a broad area of post-Pliocene or Pliocene deposits constitutes the isthmus and separates the nummulitic hills of Suez from their fellows about 30 miles to the eastward. The northern part of the isthmus is alluvium from the Nile, and its western part is covered with drifting sands. The Red Sea once extended farther north than now, and the Mediterranean farther to the southeast. Assuming the maps to be correct, the isthmus must have been open water in the late Pliocene or post-Pliocene times.

Admitting this as a fact, the difference in the fish-fauna shows that the waters over the submerged area must have been so shallow that rock-loving forms did not and could not cross it. Moreover, the region must have been overspread with silt-bearing fresh waters from the Nile. To the reef-loving fishes of the Red Sea, or of the Mediterranean, such waters would form a barrier as effective as the sand-dunes of to-day.

In earlier times the Mediterranean must have been directly connected with the Indian Ocean. This is shown from the abundance of Indian types now extinct in Europe, in the Eocene deposits of Italy.

We are therefore led to these conclusions:

1. There is no evidence, derivable from the fishes, of the submergence of the Isthmus of Suez since Miocene times.
2. If the isthmus was submerged in Pliocene or post-Pliocene times the resultant channel was shallow and muddy, so that ordinary marine fishes or fishes of rock-bottoms, or of deep waters, did not cross it.
3. It formed an open water-way to brackish-water fishes only.
4. The types common to Japan and the Mediterranean did not enter either region from the other, by way of the Red Sea, at least not in recent times.
5. As most of these are found also in India or Australia or both, their dispersion was probably around the south coast of Africa or by the Cape of Good Hope.
6. In Eocene times the Mediterranean and the Indian Ocean were fully connected.

We may then conclude that the resemblance of the Mediterranean fish-fauna to that of Japan or India is no more than might be expected, the present contour of the continents being permanent for the period of duration of the present genera and species. The imagined removal of barriers on any large scale would necessitate much closer resemblances than those which actually exist.

Isthmus of Panama as a Barrier.—Conditions in some regards parallel with those of the Isthmus of Suez exist in but one other region—the Isthmus of Panama. Here the first observers were very strongly impressed by the resemblance of forms. Nearly half the genera found on the two sides of this isthmus are common to both sides. Taking those of the Pacific shore for first consideration, we find that three fourths of the genera of the Panama fauna occur in the West Indies as well. This identity is many times greater than that existing at the Isthmus of Suez. Moreover, while the Cape of Good Hope offers no impassable barrier to distribution, the same is not true of the southern part of South America. The subarctic climate of Cape Horn has doubtless formed a complete check to the movements of tropical fishes for a vast period of geologic time.

But curiously enough, this marked resemblance is confined chiefly to the genera, and does not extend to the species on the two shores. Of 1,400 species of fishes recorded from tropical America north of the equator, only about 70 are common to the two coasts. The number of shore-fishes common is still less. In the 70 are included a certain number of cosmopolitan types which might have reached either shore from the Old World. A few others invade brackish or fresh waters and may possibly have passed, in one way or another, across the Isthmus of Nicaragua. Of fishes strictly marine, strictly littoral, and not known from Asia or Polynesia, scarcely any species are left as common to the two sides. This seems to show that no waterway has existed across the isthmus within the lifetime, whatever that may be, of the existing species. The close resemblance of genera shows apparently with almost equal certainty that such a waterway has existed, and within the period of existence of the groups called genera. How long a species of fish may endure unchanged no one knows, but we know that in this regard great differences must exist in different groups. Assuming that different species crossed the Isthmus of Panama in Miocene times, we should not be surprised to find that a few remain to all appearances unchanged; that a much larger number have become «representative» species, closely related forms retaining relations to the environment of those of the parent form, and, finally, that a few species have been radically altered.

This is exactly what has taken place at the Isthmus of Panama with the marine shore-fishes, although, curiously enough, the movement of genera seems to have been chiefly from the Atlantic to the Pacific.

As to the localities inhabited by fishes, we may roughly divide the species into marine species and fresh-water species. The marine species may be again divided into three main categories according to differences in vertical distribution, the pelagic, bassalian and littoral fishes.

Pelagic Fishes.— Pelagic fishes are those inhabiting the open sea and ranging widely within given limits of temperature. In this series some species are practically cosmopolitan. In other cases the genera are so. Each school or group of individuals has its breeding-place, and from the isolation of breeding-districts new species may be conceived to arise. The pelagic types have reached a species of equilibrium in distribution. Each type may be found where suitable conditions exist, and the distribution of species throws little light on questions of distribution of shore-fishes. Yet among these species are all degree of localization. The pelagic fishes shade into the shore-fishes on the one hand and into the deep-sea fishes on the other.

Bassalian Fishes.— The vast group of bassalian or deep-sea fishes includes those form which live below the line of adequate light. These, too, are localized in their distribution, and to a much greater extent than was formerly supposed. Yet, as they dwell below the influence of the sun's rays, zones and surface temperatures are nearly alike to them, and the same forms may be found in the arctic or under the equator. Their differences in distribution are largely vertical, some living at greater depths than others, and they shade off by degrees from bathybial into semi-bathybial, and finally into ordinary pelagic and ordinary shore-types. See DEEP-SEA LIFE.

Littoral Fishes.— The shore-fishes are in general the most highly specialized in their respective groups, because exposed to the greatest variety of selecting conditions and of competition. Their distribution in space is more definite than that of the pelagic and bassalian types, and they may be more definitely assigned to geographical areas.

Distribution by Coast-lines.— The distribution of littoral fishes is best indicated not by realms or areas, but as forming four parallel series, corresponding to the four great north and south continental outlines. Each of these series may be represented as beginning at the north in the Arctic fauna, practically identical in each of the four series, actually identical in the two Pacific series. Passing southward, forms are arranged according to temperature. One by one in each series, the Arctic types disappear; subarctic, temperate, and semi-tropical types take their places, giving way in turn to south-temperate and Antarctic forms. The distribution of these is modified by barriers and by currents, yet though genera and species may be different, each isotherm is represented in each series by certain general types of fishes.

Distribution of Fresh-water Fishes.—As to their distribution in the streams, the fresh-water fishes may be subdivided as follows:

1. Lowland fishes; as the bowfin, pirate-perch, large-mouthed black bass, sun-fishes, and some catfishes.
2. Channel fishes; as the channel catfish, the mooneye, garpike, buffalo-fishes, and drum.
3. Upland fishes; as many of the darters, shiners and suckers, and the small-mouthed black bass.
4. Mountain fishes; as the brook-trout, and many of the darters and minnows.

To these we may add, (5) the more or less distinct classes of lake fishes, inhabiting only the waters which are deep, clear, and cold, as the various species of whitefish and the Great-Lake trout; (6) anadromous fishes, or those which run up from the sea to spawn in fresh waters, as the salmon, sturgeon, shad, and striped bass; (7) catadromous fishes, like the eel, which pass down to spawn in the sea; and (8) brackish-water fishes, which thrive best in the debatable waters of the river-mouths, as most of the sticklebacks and the killifishes.

As regards the range of species, we have every possible gradation from those which seem to be confined to a single river, and are rare even in their restricted habitat, to those which are in a measure cosmopolitan, ranging everywhere in suitable waters.

Still again, we have all degrees of constancy and inconstancy in what we regard as the characters of a species. Those found only in a single river-basin are usually uniform enough; but the species having a wide range usually vary much in different localities. Such variations have at different times been taken to be the indications of as many different species.

Where species can readily migrate their uniformity is preserved; but whenever a form becomes localized its representatives assume some characters not shared by the species as a whole. When we can trace, as we often can, the disappearance by degrees of these characters, such forms no longer represent to us distinct species. In cases where the connecting forms are extinct, or at least not represented in collections, each form which is apparently different must be regarded as a distinct species.

Barriers to River Fishes.— The existence of boundaries to the range of species therefore implies the existence of barriers to their diffusion. We may now consider these barriers and, in the same connection, the degree to which they may be overcome.

Least important of these are the barriers which may exist within the limits of any single basin, and which tend to prevent a free diffusion through its waters of species inhabiting any portion of it. In streams flowing southward, or across different parallels of latitude, the difference in climate becomes a matter of importance. The distribution of species is governed very largely by the temperature of the water. Each species has its range in this respect — the free-swimming fishes, notably the trout, being most affected by it; the mud-loving or bottom fishes, like the catfishes, least. The latter can reach the cool bottoms in hot weather, or the warm bottoms in cold weather, thus keeping their own temperature more even than that of the surface of the water. Although water communciation is perfectly free for most of the length of the Mississippi, there is a material difference between the faunas of the streams in Minnesota and in Louisiana. This difference is caused chiefly by the different temperature occupying the difference in latitude. That a similar difference in longitude, with free water communication, has no appreciable importance, is shown by the almost absolute identity of the fish-faunas of Lake Winnebago and Lake Champlain. While many large fishes range freely up and down the Mississippi, a majority of the species do not do so, and the fauna of the upper Mississippi has more in common with that of the tributaries of Lake Michigan than it has with that of the Red River or the Arkansas. The influence of climate is again shown in the paucity of the fauna of the cold waters of Lake Superior, as compared with that of Lake Michigan. The majority of our species cannot endure the cold. In general, therefore, cold or northern waters contain fewer species than southern waters do, though the number of individuals of any one kind may be greater. This is shown in all waters, fresh or salt. The fisheries of the northern seas are more extensive than those of the tropics. There are more fishes there, but they are far less varied in kind.

But in most streams the difference in latitude is insignificant, and the chief differences in temperature come from differences in elevation, or from the distance of the waters from the colder source. Often the lowland waters are so different in character as to produce a marked change in the quality of their faunas. These lowland waters may form a barrier to the free movements of upland fishes; but that this barrier is not impassable is shown by the identity of the fishes in the streams on the uplands of middle Tennessee with those of the Holston and French Broad. Again, streams of the Ozark Mountains, similar in character to the rivers of east Tennessee, have an essentially similar fish-fauna, although between the Ozarks and the Cumberland Range lies an area of lowland bayous, into which such fishes are never known to penetrate. We can, however, imagine that these upland fishes may be sometimes swept down from one side or the other into the Mississippi, from which they might ascend on the other side. But such transfers certainly do not often happen. This is apparent from the fact that the two faunas are not quite identical, and in some cases the same species are represented by perceptibly different varieties on one side and the other. The time of commingling of these faunas is perhaps now past, and it may have occurred only when the climate of the intervening regions was colder than at present.

The effects of waterfalls and cascades as barriers to the diffusion of most species is self-evident; but the importance of such obstacles is less, in the course of time, than might be expected. In one way or another very many species have passed these barriers. The falls of the Cumberland limit the range of most of the larger fishes of the river, but the streams above it have their quota of darters and minnows. It is evident that the past history of the stream must enter as a factor into this discussion, but this past history it is not always possible to trace. Dams and artificial waterfalls now check the free movement of many species, especially those of migratory habits; while, conversely, numerous other species have extended their range through the agency of canals.

Every year fishes are swept down the rivers by the winter floods; and in the spring, as the spawning season approaches, almost every species is found working its way up the stream. In some cases, notably that of the quinnat-salmon and the red salmon, the length of these migrations is surprisingly great. To some species rapids and shallows have proved a sufficient barrier, and other kinds have been kept back by unfavorable conditions of various sorts. Streams whose waters are charged with silt or sediment, as the Mississippi, Arkansas, or Brazos, do not invite fishes; and even the occasional floods of red mud, such as disfigure otherwise clear streams, like the Red River or the Colorado (of Texas), are unfavorable. Extremely unfavorable also is the condition which obtains in many rivers of the southwest; as for example, the Red River, the Sabine, and the Trinity, which are full from bank to bank in winter and spring, and which dwindle to mere rivulets in the autumn droughts.

In general, those streams which have conditions most favorable to fish-life will be found to contain the greatest number of species.

There can be no doubt that the general tendency is for each species to extend its range more and more widely until all localities suitable for its growth are included. The various agencies of dispersal which have existed in the past are still in operation. There is apparently no limit to their action. It is probable that new "colonies" of one species or another may be planted each year in waters not heretofore inhabited by such species. But such colonies become permanent only where the conditions are so favorable that the species can hold its own in the struggle for food and subsistence. That various modifications in the habitat of certain species have been caused by human agencies is of course too well known to need discussion here.

Of watersheds in the United States the most important and most effective is unquestionably that of the main chain of the Rocky Mountains. This is due in part to its great height, still more to its great breadth, and most of all, perhaps, to the fact that (Two Ocean Pass excepted) it is nowhere broken by the passage of a river. In the few cases when species have crossed this barrier a break in the chain (as the Two Ocean Pass in Wyoming connecting the Snake River with the Yellowstone) has now been recorded.

Habitat of Species.— Each species finds its habitat fitted to its life, and then in turn is forced to adapt itself to this habitat. Any other kind of habitat then appears as a barrier to its distribution. Thus to a fish of the ripples a stretch of still water becomes a barrier. A species adapted to sandy bottoms will seldom force its way through swift waters or among weeds or rocks.

The stream that has the greatest variety of animals in it would be one (1) connected with a large river; (2) in a warm climate; (3) with clear water, and (4) little fluctuation from winter to summer; (5) with little change in the clearness of the water; (6) a gravelly bottom; (7) preferably of limestone, and (8) covered in its quiet reaches and its ripples with water-weeds. These conditions are best realized in the tributaries of the Ohio, Cumberland, Tennessee, and Ozark rivers among American streams, and it is in them that the greatest number of species of fresh-water animals (fishes, crayfishes, mussels, etc.) has been recorded. These streams approach most nearly to the ideal homes for animals of the fresh waters. The streams of Wisconsin, Michigan, and the Columbia region have many advantages, but are too cold. Those of Illinois, Iowa, northern Missouri, and Kansas are too sluggish, and sometimes run muddy. Those of Texas and California shrink too much in the summer, and are too isolated. The streams of the Atlantic coast are less isolated, but none connect with a great basin, and those of New England run too cold for the great mass of the species. For similar reasons the fresh-water animal life of Europe is relatively scanty, that of the Danube and Volga being richest. The animal life of the fresh water of South America centres in the Amazon, and that of Africa in the Nile, the Niger, and the Kongo. The great rivers of Siberia, like the Yukon in Alaska and the Mackenzie River in British America, have but few forms of fresh-water animals, though those kinds fitted for life in cold, clear water exist in great abundance. See FISH; ICHTHYOLOGY.

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Fishing Cat, a wild cat (*Felis viverrina*), native to eastern India and eastward. It is nearly three feet long, and has a tapering tail about a foot in length. It is dark-gray or brown, striped and spotted with darker color; the tail is barred, and the throat and breast are quite white. Though it is a fierce animal, and has been known to carry off infants, it lives, generally, by catching fish and shellfish.

Fishing Frog, a fish. See GOOSEFISH.

Fishing Laws. See GAME LAWS.

Fishkill Landing, or **Fishkill-on-Hudson,** N. Y., in Dutchess County; on the Hudson River, the New York C., and a branch of the New York, N. H. & H. R.R.'s. It is connected with the West Shore R.R., at Newburg, by ferry, and with many of the towns and cities along the Hudson River by electric railways. It is about 55 miles north of New York. It was used as a «landing» as early as the times of exploration along the Hudson, and the first settlement was made about the last of the 17th century. During the Revolution the New York Provincial Convention met here, and it shares with Newburg and Mattewan the distinction of being the military depot for supplies for the American troops and frequently the headquarters of Washington. When peace was restored, its advantages as a trading post for the settlements on the east side of the Hudson gave it opportunities that caused it to become quite a good-sized village in the early part of the 18th century. Its chief manufactures are the Corliss engines and rubber goods. Coal and food products are shipped here in large quantities from New York. In 1783 the Society of Cincinnati was organized here. Consult: 'New England Magazine,' No. 5, Vol. XIV., 'The Birthplace of the Order of Cincinnati'; Smith, 'History of Dutchess County.' Pop. (1910) 3,902.

Fishway, a device to enable fish, especially salmon, to ascend a fall. It may consist of a series of steps over which the water descends, turning a fall into a cascade, and sometimes known as a fish ladder; or it may consist of a chute for diminishing the velocity, and assisting the fish to the level above the dam.

Fisk, Clinton Bowen, American politician: b. Griggsville, N. Y., 8 Dec. 1828; d. New York 9 July 1890. In the Civil War he rose from private to brevet brigadier-general of volunteers 1865. He was assistant commissioner in the Freedmen's Bureau and founder of Fisk University, Nashville, Tenn., 1865, an institution for the education of colored persons of both sexes. He became a member of the Indian Commission 1873, joining the Prohibition party 1884, and running as its candidate for the governorship of New Jersey 1886, and for the presidency 1888.

Fisk, Franklin W., American educator: b. Hopkinton, Vt., 1820; d. Chicago 4 July 1901. He was graduated at Yale University in 1849; became professor of rhetoric in the Seminary of Beloit, Wis., and was called to the Chicago Theological Seminary when that school was founded in 1859. Subsequently he was president of the seminary till 1900, when he resigned.

Fisk, James, American stock speculator: b. Bennington, Vt., 1834; d. New York 1872. He became a member of the Boston mercantile firm of Jordan & Marsh, drove shrewd bargains with the government during the Civil War; later opened a broker's office in New York, and was employed with one Belden by Daniel Drew (q.v.) as agent in Drew's struggle with Cornelius Vanderbilt for control of the Erie Railway. The Drew-Fisk and Gould-Eldridge interests in concert succeeded in forcing out Vanderbilt and in placing Gould and Fisk in power, the former as president, the latter vice-president and comptroller of the road. The activity of the two in bribery and corruption involved State and Federal officials, and at its climax brought about the gold conspiracy of 1869 and the well-known «Black Friday» (24 Sept. 1869), when the efforts of the combination to corner the gold market resulted in financial panic. Fisk was shot after a quarrel by E. S. Stokes, a business associate.

Fisk, Wilbur, American Methodist clergyman and educator: b. Brattleboro, Vt., 31 Aug. 1792; d. 22 Feb. 1839. He was graduated from Brown University 1815, and a few years later entered the Methodist ministry. In 1825 he became the principal of the Wesleyan Academy at Wilbraham, an institution which had already under his auspices risen to considerable eminence, and continued in this position until 1830, when he was elected president of the Wesleyan University at Middletown, Conn., which under his charge became exceedingly popular. He was twice elected to the office of bishop, but declined both honors. He published 'Travels in Europe' (1838), and other works.

Fisk University, a coeducational institution in Nashville, Tenn.; founded in 1866 under the auspices of the Congregational Church; reported at the close of 1910: Professors and instructors, 35; students, 462; volumes in the library, 6,778.

Fiske, Amos Kidder, American editor and author: b. Whitefield, N. H., 12 May 1842. He was graduated at Harvard 1866, and admitted to the bar 1868. He collaborated with George Ticknor Curtis in the 'Life of Daniel Webster' and was a large contributor to the revised edition of the 'American Encyclopædia' (1873–6). He served for 20 years on the editorial staff of the New York *Times*, joining the staff of the *Mail and Express* 1900. His published works are: 'Midnight Talks at the Club' (1890); 'Beyond the Bourn' (1891); 'The Jewish Scriptures' (1896); 'The Myths of Israel' (1897); 'The Story of the Philippines' (1898); 'The West Indies' (1899).

Fiske, Bradley Allen, American naval officer: b. Lyons, N. Y., 13 June 1854. He was appointed a cadet midshipman in the United States navy in 1870; and became lieutenant-commander 30 March 1900. He invented a boat detaching and attaching apparatus for warships in 1877; the first electric ammunition used in the navy in 1888; electric gun-training apparatus and electric steering gear the same year; range- and position-finders in 1889; improvements of the range-finder and electric steering gear in 1895; and an electrical apparatus for transmitting the orders of a ship's commander from the deck bridge to the engine room in 1896; and has been attached to the Naval Bureau of Ordnance since 1895. Author: 'Electricity and Electrical Engineering'; 'Electricity in Theory and Practice.'

Fiske, Daniel Willard, American educator: b. Ellisburg, N. Y., 11 Nov. 1831; d. Frankfort-on-the-Main, Germany, 17 Sept. 1904. He studied at Hamilton College and in Europe, was an instructor in English and lecturer on American literature in the University of Upsala, Sweden, in 1849–52; member of the Astor Library (New York) staff 1852–9; and general secretary of the American Geographical Society in 1859–60. After having held a post in the Vienna legation (1861–2), he was editor of the Syracuse (N. Y.) *Journal* (1864–6), of the Hartford (Conn.) *Courant* (1867), and librarian-in-chief and professor of the languages of northern Europe in Cornell University. He removed to Florence, Italy, in 1881.

Fiske, John (originally **Edmund Fiske Green**), American historian and philosopher: b. Hartford, Conn., 30 March 1842; d. Gloucester, Mass., 4 July 1901. In 1855 he assumed the name of his maternal great-grandfather, John Fiske, of Middletown, Conn. In 1863 he was graduated from Harvard, in 1865 from the Harvard Law School, in 1864 was admitted to the Suffolk bar, but never entered legal practice. In 1861 he published in the 'National Quarterly Review' a notable critical article ('Mr. Buckle's Fallacies') on Buckle's 'History of Civilization in England.' From 1869 to 1879 he was at Harvard, first as a brilliant university lecturer in philosophy, and from 1872 as assistant librarian. In 1884 he received appointment to the chair of American history in Washington University (St. Louis, Mo.), where for some years he held annual lecture courses. His reputation as a lecturer was considerable, also, in Great Britain, where he delivered addresses on American history in 1879 at University College, London, and in 1880 at the Royal Institution. His earlier recognition, however, was chiefly as a thinker and writer in evolutionary philosophy, in particular as the foremost expounder to English-speaking students of Herbert Spencer's philosophic system. In this popularization of Spencer, best represented by his 'Outlines of Cosmic Philosophy' (1874), his lucidity won strong approbation from Darwin. From 1879 his attention was turned toward American history, largely through researches made by him in American aboriginal life in connection with a projected work on the Aryans. Thenceforth his philosophic studies took subordinate place, though he wrote in this field occasional volumes of much interest, and in his 'Idea of God' (1885) and 'Origin of Evil' gave ultimate presentation of his confirmed views on questions of philosophy and religion. In his series of historical writings, forming broadly a continuous account of events from the earliest discoveries to the beginnings of Federal government, he displayed a marked ability for clear and interesting narrative, and infused a particular interest into the adventurous characters and daring deeds of the period of exploration. He fails at times in points of minor accuracy, but in arrangement, judgment, proportion, and dramatic interest he exercised a strong influence on the progress of American historical studies in this country. His style here is not inferior to that of his philosophical treatises. He worked with tremendous energy, and, though dying prematurely, had accomplished an impressive amount of literary labor. Among the titles of his further volumes are: 'Myths and Mythmakers' (1872); 'The Unseen World' (1876); 'Darwinism and Other Essays' (1879; rev. ed. 1885); 'Excursions of an Evolutionist' (1883); 'The Destiny of Man' (1884); 'American Political Ideas' (1885); 'The Critical Period of American History' (1888); 'The War of Independence' (1889); 'The Beginnings of New England' (1889–98); 'Civil Government in the United States' (1890); 'The American Revolution' (1891); 'The Discovery of America' (1892); 'History of the United States for Schools' (1894); 'Edward Livingston Youmans' (1894); 'Old Virginia and Her Neighbors’ (1897); ‘The Dutch and Quaker Colonies in America’ (1899); ‘Through Nature to God’ (1899); ‘New France and New England’ (1902); and ‘Essays, Literary and Historical’ (1902).

Fiske, Lewis Ransom, American Methodist minister and educator: b. Penfield, N. Y., 24 Dec. 1825; d. 1901. He was graduated at the University of Michigan 1850, entered the Methodist ministry, and held pastorates in Jackson, Ann Arbor, and Detroit. He taught in the State Normal School and the State Agricultural College of Michigan; was president of Albion College 1877–98; and was professor emeritus of philosophy there from 1898. He was editor of the Michigan ‘Christian Advocate’ (1875–9). He published: ‘To-day and To-morrow’ (1898); ‘Choosing a Life-Work’ (1900); ‘Human Life and Its Forces’ (1901).

Fiske, Stephen, American editor and author: b. New Brunswick, N. J., 22 Nov. 1840. He was graduated at Rutgers College and early became an editorial writer on the staff of the New York *Herald,* for which newspaper he acted as special correspondent in the suite of the Prince of Wales, now king of England, while the Prince was traveling in the United States and Canada, and later as war correspondent. For many years he was dramatic critic of the *Herald*; afterward managing the St. James Theatre and the Royal English Opera Company in London, and the Fifth Avenue Theatre, New York, presenting Modjeska and Mary Anderson. Among his works are: ‘English Photographs’; ‘Off-hand Portraits of Prominent New Yorkers’; and several plays including: ‘Corporal Cartouche’; ‘Martin Chuzzlewit’; ‘My Noble Son-in-Law’; ‘Robert Rabagas.’

Fission, fish'ŏn, a term in biology applied to various separation processes, as cell-division of the bacteria and related algæ, and the dividing of chromosonus (see Embryology). When used in reference to hydroids and related animals it means the process of reproduction by germination or budding, in which the offspring arises as a bud from the parent and is then constricted off. See Budding.

Fissirostres, fis-ĭ-ros'trēz, one of the four or five tribes or sub-orders into which the insessorial birds were divided by early ornithologists. The term is no longer used, as the group it represented was not a natural one. It contained the nightjars, swifts, trogons, and various other more or less related families.

Fissure, fish'ŭr. Any rock fracture or crack is a fissure, but generally the term is applied to fractures of some size. If accompanied by dislocation of the rocks the fissure is termed a fault. The term true fissure vein so frequently used by miners should be applied to a vein formed along a fault. Such a vein is apt to have considerable length and sometimes great depth. As the term is commonly used by mine promoters it really means nothing except that the promoter wants to give the impression that the mine he is trying to sell is on a vein that will go down indefinitely. See Fault; Joint; Ore Deposits.

Fissure. See Brain; Rectum.

Fissure Needle, a spiral needle for drawing together the gaping lips of wounds. By revolution, the point is made to pierce the lips alternately, carrying its thread or silver wire with it. See Surgery.

Fis'tula, a burrow or tract through the tissues. Usually the term is applied to tracts between cavities lined by mucous membrane or from a cavity to the body surface. The lining of the tract is infected with granulation tissues, which make it difficult to heal. They are formed by suppuration, or by a low grade of infection along the course of a false passage made by foreign bodies or surgical instruments. The most frequent sites are the anus, the rectum, the intestines, the bladder, the vagina, and the salivary ducts. Fistula in ano is always secondary to an abscess in the rectum or perirectal tissue. Abscesses here are difficult to heal, owing to constant inflection from the fæces and the construction of the parts. Chronic alcoholics, consumptives, and otherwise debilitated subjects are particularly liable to these abscesses, and consequently to fistulæ. When the passage is from the bowel to the skin, with openings at both points, it is said to be complete. Blind internal and blind external are two other common varieties. The tissues about the anus may be riddled with these tracts. The conversion of the tract into an open wound must be made before a positive cure will result.

Fistulina. See Fungi.

Fitch, Ebenezer, D.D., American clergyman: b. Norwich, Conn., 26 Sept. 1756; d. West Bloomfield, N. Y., 21 March 1833. He was graduated at Yale College in 1777, where in 1780 he was appointed tutor, and continued to act as such for several years. In 1790 he was chosen preceptor of the academy in Williamstown, Mass., and when in 1793 it grew into and was incorporated as Williams College, he was elected its first president, which office he filled with ability and success till 1815, when, resigning, he was chosen pastor of the Presbyterian Church in West Bloomfield, N. Y. This charge he held till 1827.

Fitch, John, American inventor: b. East Windsor, Conn., 21 Jan. 1743; d. Bardstown, Ky., 2 July 1798. At the outbreak of the Revolution he became a gunsmith for the American troops, with whom he wintered at Valley Forge. He next made surveying and trading tours in the West, and after escaping from captivity among the Indians returned to Pennsylvania, where in 1785 he completed his first model of a steamboat; this had wheels at the sides, which were replaced in the following year with paddles or oars. In the face of discouragement and neglect he succeeded in constructing a vessel, 45 feet long and 12 feet beam, with an engine of 12-inch cylinder, which made a successful trial trip on the Delaware, at Philadelphia, 22 Aug. 1787. Larger vessels were built in 1788 and 1790, the latter being run as a passenger boat, at 8 miles an hour, to Burlington (20 miles) throughout the summer. Misfortune, however, dogged «poor John Fitch's» steps; his supporters fell away; and in 1793 he went to France to construct a steamboat, only to find his project frustrated by the Revolution there. It is said that his plans and specifications were deposited with the American consul at L'Orient, who for several months entrusted them to Robert Fulton (q.v.); and the latter's steamboat certainly was in 1817 declared by a committee of the New

York legislature to be "in substance the invention patented by John Fitch in 1791." Penniless and dejected, Fitch worked his passage back to America, where in the summer of 1798 he is said to have committed suicide at Bardstown, Ky. Consult Westcott, 'Life of John Fitch, Inventor of the Steamboat' (1857); Thurston, 'Growth of the Steam Engine' (1878).

Fitch, Sir Joshua Girling, English educationist: b. 1824; d. London August 1903. He was educated at the University of London. In 1852 he was appointed principal of the Normal College of the British and Foreign School Society and in 1877 government school inspector for the eastern counties. He was also examiner in English and member of the senate in the University of London. In 1888 he visited the United States with a view of studying transatlantic educational methods. The result of his observations he embodied in his 'Notes on American Schools and Colleges' (1890). Among his other works may be mentioned: 'Lectures on Teaching at Cambridge' (1881); 'The Arnolds and their Influence on English Education.'

Fitch, Ralph, English merchant and voyager of the 16th century. He dealt in eastern goods, and, excited by the narratives of Drake and other voyagers, persuaded John Newbery and others to join him in an expedition to the East by way of the Mediterranean. The adventurers set sail in January 1583, landed in Syria, went to Aleppo, and traversing Mesopotamia reached Bagdad. From that city they sailed down the Tigris and through the Persian Gulf to Ormus, where they began a profitable traffic. But their success roused the jealousy of other European merchants in those parts, one of whom denounced them as heretics to the Portuguese inquisition. The Englishmen were thrown into prison at Goa, but finally released, and seeing reason to apprehend further injustice, they secretly escaped. After passing through Golconda, they traveled north through the Deccan, and visited successively Burhampoor, Mandoo, Agra, Allahabad, Benares, Patna, Tanda in Bengal, and a country called by Fitch Couche, which appears to be at the foot of the mountains of Bootan. They traveled south to Hoogly and through Orissa, passing by a port called Angeli, which they described as the seat of a great trade. It cannot now be identified. Returning to the Ganges, they saw Serampore and other towns on its lower branches, made an excursion into Tipperah, and took passage in a vessel to Negrais, in Pegu. They visited Malacca, went back to Bengal, shipped for Ceylon, and thence doubling Cape Comorin sailed to Cochin and Goa, and returned to England in 1591, by the same route they had come, after having performed the most extensive journey that had yet been made by any Europeans in India. Fitch's narrative of his travels, which may be found in Hakluyt and in Purchas' 'Pilgrims,' is exceedingly interesting not less for its quaint style than for the mass of information which it contains.

Fitch, William Clyde, American playwright and author: b. New York 2 May 1865. He was graduated at Amherst College 1886. He has written many successful plays, among them: 'Beau Brummell'; 'The Climbers'; 'The Way of the World'; 'The Girl and the Judge'; 'Barbara Frietchie'; 'The Moth and the Flame'; 'The Stubbornness of Geraldine'; etc. He is also the author of: 'The Knighting of the Twins, and Ten Other Tales' (1891); 'Some Correspondence and Six Conversations' (1896); 'A Wave of Life,' a novel.

Fitch'burg, Mass., city, one of the county-seats of Worcester County, on the New York, N. H. & H., and the Fitchburg R.R.'s; 50 miles northwest of Boston. It comprises the villages of Traskville, Rockville, South Fitchburg, West Fitchburg, and Fitchburg Centre. It contains a public library, high school, electric street railroad, electric lights, several national and savings banks, and a number of daily and weekly newspapers. The various industries employ about 5,000 people. There are manufactories of pianofortes, tools, machinery, paper, saws, electrical apparatus, steam-engines, bicycles, firearms, cotton and woolen goods, etc. Pop. (1910) 37,826.

Fitché, or **Fitchée,** fi-chā, in heraldry, pointed, like a dagger; sharpened at the lower part. Fitché is usually applied to crosses to indicate that they taper from the centre downward, or fitché at the foot, when the tapering commences only at the bottom of the cross. See HERALDRY.

Fitchett, William Henry, Australian journalist and Methodist clergyman. He was educated at Melbourne University, entered the Methodist ministry and for a time edited the Melbourne *Daily Telegraph*. He is the editor of the 'Review of Reviews' of Australia, and principal of the Methodist Ladies' College at Melbourne. He has published: 'Deeds that Won the Empire' (1897); 'Fights for the Flag' (1898); 'Stories of the Indian Mutiny'; 'How England Saved Europe' (1899); 'Wellington's Men' (1901); 'Nelson and His Captives' (1902).

Fitchew. See POLECAT.

Fitger, Arthur Heinrich Wilhelm, hīn'rĭʜ vĭl'helm fĭt'gĕr, German poet and painter: b. Delmenhorst, Oldenburg, 4 Oct. 1840. He has written several successful dramas: 'Adalbert of Bremen' (1873), with the afterpiece 'Here Empire! Here Rome!' (1875); 'The Witch' (1878); 'The Roses of Tyburn' (1888). Besides these he is the author of a short epic, 'Roland and the Rose' (1871); and two volumes of collected poems, 'Traveling Folks' (1875), and 'Winter Nights' (1881). He has painted several important friezes and other decorations at Bremen and Hamburg.

Fitts, James Franklin, American journalist and novelist: b. Lockport, N. Y., 1840; d. there 11 Jan. 1890. During the Civil War he distinguished himself on several occasions, and was rewarded with promotions. After the war he devoted himself to writing for newspapers, magazines, and syndicates. Of his novels the most popular were: 'The Parted Veil'; 'A Version'; 'A Modern Miracle'; 'Captain Kidd's Gold.'

Fitz (old French for *fils*, son), a syllable frequently forming a prefix in English surnames (Fitz-Herbert, Fitz-Clarence, Fitz-James), like the Scottish Mac, and the Irish O'. Latterly *Fitz* usually denotes illegitimate descent. There are several noble families of such origin, who include their royal progenitors in their genealogical tables.

Fitzball′, Edward, English dramatist: b. Burwell, Cambridgeshire, 1792; d. 1873. His name was orginally Ball, but he substituted the present form in 1819. He made his first dramatic success with 'The Innkeeper of Abbeville' (1820). This was succeeded by a dramatization of 'The Fortunes of Nigel' (1822); and 'Joan of Arc,' and he soon became a prolific dramatist, turning out plays to order in great number, and some of them having enormous success. Among his works are: adaptations of Scott's 'Peveril of the Peak' and 'Waverley' (1823); 'The Pilot' (200 nights); 'The Flying Dutchman' (1828); 'Jonathan Bradford' (1838) (400 nights); 'Walter Tyrrell' (1835); 'Zazezizozu' (1836); 'The Momentous Question'; 'The Miller of Derwentwater'; and libretti for several of Balfe's, Donizetti's, Bishop's and Wallace's operas. He was the author of 'Thirty-five years of a Dramatic Author's Life.'

Fitzgerald, fits-jĕr′ald, **Edward,** Lord, Irish patriot: b. near Dublin, Ireland, 15 Oct. 1763; d. 4 June 1798. He was a son of the first Duke of Leinster. He distinguished himself for intrepidity as aide-de-camp to Lord Rawdon in the American Revolution, and was severely wounded in the battle of Eutaw Springs. When the French Revolution broke out, he supported its principles, and in 1793 hastened to Paris. Here he married Pamela, the reputed daughter, it is said, of Louis Philippe Joseph, the Duke of Orleans, and Madame de Genlis. On his return to Ireland, Fitzgerald was desirous of effecting a separation of that country from England, and induced the French Directory to furnish him with a fleet and troops. A landing was attempted on several occasions, but without success, and Fitzgerald was seized, tried, and condemned to death. He died of his wounds before the time fixed for his execution, 1798. His wife married a second time, Mr. Pitcairn, the American consul at Hamburg, from whom, however, she separated soon afterward. See Moore, 'Life and Death of Edward Fitzgerald' (2d ed. 1875).

Fitzgerald, Edward, English poet: b. near Woodbridge, Suffolk, 31 March 1809; d. Merton, Norfolk, 14 June 1883. At 17 he entered Trinity College, Cambridge, where he graduated in 1830. At school and college he formed several lifelong friendships with men who afterward became celebrated in different spheres, among them being Spedding and Thackeray. At a later period he gained the friendship of Tennyson and Carlyle. His life was passed quietly — almost in retirement — in various parts of Suffolk, first at Bredfield, his birthplace, then near Ipswich, where he contracted friendships with George Crabbe, the son of his favorite English poet, and Bernard Barton, the Quaker poet; and lastly at Boulge Hall and Woodbridge. Books were his chief indoor recreation; out of doors he occupied himself at first chiefly with boating, and afterward with his garden. Fitzgerald's works are not numerous, by far the most important being his celebrated translation of the 'Rubaiyát' (or quatrains) of the Persian semi-pessimistic astronomer-poet, Omar Khayyám. Having for some time studied Persian, in 1856 he published a translation of Jámi's 'Salámán and Absál.' Three years later his *magnum opus* appeared without causing any stir, but before he died four editions had been issued. The beauty of Fitzgerald's poem is universally admitted, but some have doubted whether it does not contain more of the Englishman than of the Persian. The general consensus of opinion now seems to be that though undoubtedly embellished, altered in some ways and adapted, we have in Fitzgerald's work a real translation of Khayyám's. Other works by him are: 'Euphranor: a Dialogue on Youth' (1851); 'Polonius: a Collection of Wise Saws and Modern Instances' (1852), both of which appeared anonymously; 'Six Dramas of Calderon, freely translated by Edward Fitzgerald' (1853); and translations of Æschylus' 'Agamemnon' and the 'Œdipus' plays of Sophocles. Tennyson's poem, 'Tiresias,' was dedicated to Fitzgerald. See 'Letters and Literary Remains of Edward Fitzgerald,' edited by W. Aldis Wright (1889; new edition 1894); 'Variorum Edition of the Poetical and Prose Writings of Fitzgerald,' edited by Bentham (1902–3).

Fitzgerald, James Newbury, American Methodist bishop: b. Newark, N. J., 27 July 1837; d. Hong Kong, China, 3 April 1907. He studied law and was admitted to the New Jersey bar in 1858, but in 1862 entered the Methodist ministry. He was recording secretary of the missionary society of his denomination 1880–8, and was appointed bishop in 1888.

Fitzgerald, Oscar Penn, American Methodist bishop: b. Caswell County, N. C., 24 Aug. 1829. He was ordained a Methodist minister in Georgia 1853, went to California 1855 and became editor of the 'Pacific Methodist and Christian Spectator,' serving as State superintendent of public instruction in California 1867–71, and being appointed editor of the Nashville 'Christian Advocate' 1878. He was made a bishop of the Methodist Episcopal Church, South, 1878. His works include: 'California Sketches'; 'Christian Growth'; 'Glimpses of Truth'; 'A Life Study'; 'Centenary Cameos'; 'Bible Nights'; 'Eminent Methodists'; 'The Whetstone'; 'The Epworth Book'; 'The Menagerie'; 'Judge Longstreet'; 'Sunset Views' (1900); 'The Day and the Word' (1898); etc.

Fitzgerald, Percy Hetherington, Irish novelist and miscellaneous writer: b. Fane Valley, south Ireland, 1834. Educated at Trinity College, Dublin, he was called to the Irish bar in 1855, and was afterward a crown prosecutor on the northeastern circuit. Beside novels he has written many biographical and other works, of which the most important are: 'Life of Laurence Sterne' (1864); 'Charles Lamb: His Friends, His Haunts, and His Books' (1865); 'Charles Townshend, Wit and Statesman' (1866); 'Life of David Garrick' (1868); 'Principles of Comedy and Dramatic Effect' (1870); 'The Kembles: an Account of the Kemble Family' (1871); 'Book of Theatrical Anecdotes' (1873); 'The Romance of the English Stage' (1874); 'Life, Letters, and Writings of Charles Lamb' (1875–6); 'History of the Suez Canal' (1876); 'Croker's Boswell, and Boswell: Studies in the Life of Johnson' (1880); 'A New History of the English Stage' (1882); 'The Royal Dukes and Princesses of the Family of George III.' (1882); 'Kings and Queens of an Hour: Records of Love, Romance, Oddity, and Adventure' (1883); 'Life and Times of

William IV.' (1884); 'The Lives of the Sheridans' (1887); 'Life and Times of John Wilkes, M.P.' (1888); 'Picturesque London' (1890); 'Henry Irving: a Record of Twenty Years at the Lyceum' (1893); 'Fifty Years of Catholic Life and Social Progress' (1901).

Fitz-Gerald, Shafto Justin Adair, English novelist and dramatist: b. 9 Nov. 1859. He has published: 'Sketches from Bohemia' (1890); 'The Wonders of the Secret Cavern' (1892); 'Ballads of a Bohemian' (1893); 'A Book of Words' (1895); 'The Mighty Toltec' (1897); 'Stories of Famous Songs' (1897); 'The Grand Panjandrum' (1898); 'The Black Tulip' (1899); 'Rip Van Winkle' (1900); 'How to Make Up' (1901); and a dozen or more plays.

Fitzgib'bon, Mary Irene, American philanthropist: b. London, England, 12 May 1823; d. New York 14 Aug. 1896. She removed to New York early in life; entered the community of the Sisters of Charity at Mount St. Vincent in January 1850, and became sister superior in 1856. In 1869 Archbishop (later Cardinal) McCloskey requested her to organize a work for the care of the waifs of the diocese. On 11 Oct. 1870 the New York Foundling Asylum was opened and within a month was caring for 45 children. During the same year the legislature authorized the city to grant the asylum a site and to appropriate $100,000 toward a building, providing an equal amount should be provided by subscriptions. This amount was soon raised. At the time of Sister Irene's death, the buildings of the asylum covered an entire block and were valued at over $1,000,000. Aside from having full charge of this institution from its inception, Sister Irene raised $350,000 with which she founded the Seton Hospital for Incurables.

Fitzher'bert, Maria Anne (Smythe), morganatic wife of King George IV. of England: b. Brambridge, England, 26 July 1756; d. Brighton, England, 27 March 1837. Her first husband was Edward Weld, to whom she was married in 1775. He died within a year and she was married to Thomas Fitzherbert 1778. He died in 1781 and she was married to the Prince of Wales 21 Dec. 1785. Under the Marriage Act of 1772 the marriage might have been declared invalid if publicly acknowledged, and it would, if avowed, have changed the succession under the Act of Settlement, Mrs. Fitzherbert being a Catholic. She, however, lived with the prince as his wife, the relationship ending in 1803.

Fitzhugh', George, American lawyer: b. Prince William County, Va., 2 July 1802; d. Huntsville, Texas, 30 July 1881. He held very extreme views in reference to slavery. He published: 'Sociology for the South, or the Failure of Free Society' (1854); 'Cannibals All, or Slaves Without Masters' (1856).

Fitz-John Porter Case, The. See PORTER, FITZ-JOHN.

Fitzmaurice, fits-mor'ris, LORD **Edmond George,** English politician: b. 19 June 1846. He sat in the House of Commons for Calne 1869–85, and was under-secretary for foreign affairs 1882–5. He has published: 'Life of William, Earl of Shelburne' (1875–7); 'Sir William Petty, the Political Economist' (1895).

Fitzmaurice-Kelly, James, English scholar: b. 20 June 1858. He was examiner in Spanish at Oxford University 1900–2, and has published: 'The Life of Miguel de Cervantes Saavedra' (1892); 'History of Spanish Literature' (1898); and edited the complete works of Cervantes.

Fitzpat'rick, Benjamin, American politician: b. Green County, Ga., 20 June 1802; d. 1869. He settled in Alabama in early life, studied law, and in 1821 obtained license to practise. He was soon afterward elected State's attorney, and held that office until 1829. In 1841 he was elected governor, and in 1843 was re-elected without opposition. In 1848 he was appointed United States senator to fill a vacancy, and continued in the Senate until 1861.

Fitzpatrick, Charles, Canadian lawyer and politician: b. Quebec 19 Dec. 1853. He was graduated at Laval University in 1873 and being admitted to the bar in 1876, was appointed crown prosecutor for the city and district of Quebec 1879 and 1887. He was a member of the Quebec Assembly 1890–6, and was elected to the Dominion Parliament 1896, becoming solicitor-general in the same year.

Fitzralph', Richard, English prelate: b. Dundalk, Ireland, about 1300; d. Avignon 16 Nov. 1360. He took orders, becoming Fellow of Balliol College, Oxford, and being made chancellor 1333. He was archbishop of Armagh 1347. He was a popular preacher and in favor with the Pope at Avignon, interesting himself greatly in the Armenian question, and also in the case of the secular clergy against the mendicant friars in England. In connection with the former he wrote an argument, 'Summa in Questionibus Armeniorum,' and in reference to the latter a treatise 'De Pauperie Salvatoris.' When summoned by the friars before Pope Innocent VI. he defended himself in a notable sermon, 'Defensio Curatorum,' dying before the case was decided. His bones were taken to Dundalk 1370, where his tomb became an object of veneration.

Fitzroy' River, the name of two Australian rivers, one in western Australia and one in Queensland. The former rises in the King Leopold Mountains and empties in King Sound; length 300 miles. The Queensland River is formed by the junction of the Mackenzie and the Dawson and empties into Keppel Bay.

Fiume, fē-oo'mĕ, **Austria-Hungary,** seaport town on the small river Fiumara; 40 miles southeast of Trieste. Some of the manufactures include tobacco, paper, leather, chemicals, soap, torpedoes, and rosoglio, and it carries on shipbuilding. Since 1872 the Hungarian government has spent large sums in providing moles, quays, docks, and other accommodations, with the result of immensely increasing the trade. The principal exports are corn, sugar, tobacco, wood, fruit, refined petroleum, etc.; the principal imports — wine, coal, jute, rice, cotton, salt, etc. Pop. 29,494.

Five or Nine, a game, analogous to dominoes, played with a pack of 52 cards. The name is derived from the fact that the player leading off to the table must play a five or a nine; then the cards are played in sequence, as dominoes are placed. The rules of the game are similar to those governing dominoes. The game is also called domino whist. See DOMINOES.

Five-cent Piece, Half-dime, or "Nickel." Silver half-dimes were the first coins struck under the Coinage Act of 1792. None were coined in 1798, 1799, 1804, or 1806 to 1828. See COINS; NUMISMATICS.

Five-fingers. A starfish (q.v.).

Five Forks, Battle of. At the close of the battle of Dinwiddie Court House, 31 March 1865, Gen. Sheridan was holding position in front of the place, Gen. Pickett, with infantry and cavalry, confronting him. At 12 P.M. Pickett, threatened by Warren's Fifth corps on his left, ordered a retreat to Five Forks to protect his communications with the South Side Railroad. Sheridan followed him at daylight with Devin's and Custer's divisions, Crook's division being thrown on roads to the left. Pickett was found entrenched at Five Forks. By 1 P.M. Sheridan's cavalry had worked close up to Pickett's lines, and Sheridan ordered up the Fifth corps. MacKenzie's cavalry division, advancing on the extreme right, drove back Robert's cavalry and gained the White Oak road.

At 4 P.M. Warren had formed his lines, Ayres' and Crawford's divisions in double lines, with one brigade in reserve, on the left and right respectively of the Gravelly Run Church road. A few moments brought Warren to the White Oak road, and Ayres, whose right had crossed it, received a severe fire upon his left, and at once changed front and attacked the return of the entrenchments. Crawford kept straight on through the woods and, receiving fire from Munford's cavalry, swerved to the right, thus isolating his division from Ayres, and Griffin followed Crawford. But Griffin and his brigade commanders taking in the situation, soon marched by the left flank and protected Ayres' flank, which had been thrown into some confusion. Ayres meanwhile, connecting with the cavalry on his left, had made a gallant charge, carried the left of the Confederate works and, with support on the left and right, swept down inside them to and beyond Five Forks, capturing many prisoners. The only stand the Confederates tried to make was on the road leading to the railroad, and at this point they were pressed so closely by Griffin and Crawford that they soon gave way. On the right Warren took Crawford's division in hand, changed its direction to the left and, advancing in rear of the Confederate infantry line, with MacKenzie's cavalry on the right, drove Munford's cavalry, continually turning the left of the Confederates opposing Ayres and Griffin, gained the road leading to the South Side Railroad, forced Munford north of Hatcher's Run, and took four guns and many prisoners. On the extreme left Custer had a severe fight with cavalry and infantry, and gained but little ground until Devin and Ayres, advancing behind the works, drove the infantry out. The Confederate cavalry made no further stand, save to cover the retreat, and just before dark Custer, in connection with an attack by a small body of the Fifth corps, led by Warren in person, drove the last of the Confederates westward on the White Oak road, and followed them until long after dark. The battle was one of the most decisive of the War. The Confederates were totally routed, losing over 5,000 men captured, 6 guns, and 11 colors. The Union loss was 830 killed and wounded, of which the Fifth corps lost 634. The Confederate loss in killed and wounded is not definitely known. Consult: 'Official Records,' Vol. XLVI.; Humphreys, 'The Virginia Campaign of 1864-5'; Powell, 'The Fifth Army Corps'; Sheridan, 'Personal Memoirs,' Vol. II; The Century Company's 'Battles and Leaders of the Civil War,' Vol. IV.

E. A. CARMAN.

Five Members, The, whom Charles I. attempted to arrest early in 1642, were John Pym, John Hampden, Denzil Holles, Sir Arthur Haselrig, and William Strode, representing in the Commons Tavistock, Buckinghamshire, Dorchester, Leicestershire, and Dorchester respectively. The king, expecting an impeachment of the queen, determined to prevent it by impeaching these commoners along with Lord Kimbolton. The impeachment was subsequently abandoned when the Commons had declared against the illegality of his procedure. See ENGLAND.

Five-mile Act, an old English law, passed in 1665, which forbade non-conformist pastors who refused to take an oath of non-resistance to come within five miles of any corporation in which they had preached since the passing of the Act of Oblivion in 1660. The law was repealed in 1688.

Five Nations, a confederacy consisting of five tribes of Indians who lived in the western and central part of what is now the State of New York. The five tribes were: the Cayugas, Mohawks, Oneidas, Onondagas, and Senecas. In 1712 the Tuscaroras were taken into the confederacy, and they were then known as the Iroquois, or the Six Nations. See IROQUOIS, OR THE SIX NATIONS.

Five Points, New York, a locality between Centre and Reade streets and Park Row. At one time it was noted as a resort for criminals and "hard cases." The Ladies' Home Missionary Society of the Methodist Episcopal Church began a reform work at Five Points in 1850, and they have been most successful. The Church of the Ascension contributed funds to establish an industrial school which, in 1854, was incorporated. The mission secured by purchase and by building an excellent home, which they still occupy; and thousands of children have been reclaimed and educated through the efforts of the mission workers. The character of the place has changed greatly for the better.

Five Points of Doctrine, the principal subjects of doctrine which are disputed topics between Arminians and Calvinists. They are: (1) extent of the atonement; (2) predestination; (3) free will; (4) grace; (5) final perseverance. Various efforts have been made to settle the differences; they were fully discussed at the Synod of Dort, in Holland, in 1618-19; at Cambridge, in England, in 1594, and at two other conferences held in England in 1626.

Five-twenties (that is, redeemable after 5 years and payable in 20), 6 per cent gold bonds issued in 1862, 1864, and 1865. See DEBT, UNITED STATES.

Fives, an English game, originally called hand-tennis, in which the ball is struck against a wall. It is played either in close or in open courts, of various shapes and proportions. The game is known as hand-fives or bat-fives, according as the ball is struck by the open hand or a small wooden bat. The origin of the name is disputed. Also a disease in horses, resembling the staggers, and consisting of an inflammation of the parotid glands; written also vives.

Fixed Oils, in medicine, oils used as demulcents, laxatives, and in external application as emollients. Some, notably linseed oil, while still in the seed, are very useful in poultices because of the high specific heat of the oils. By means of this specific heat the poultice stays warm much longer. Others of the fixed oils are useful as foods — cod-liver oil, peanut oil, etc.

Fixing. (1) In machinery, a piece of cast iron adapted to carry pillow blocks and the like. When it is built into a wall it is called a wall fixing, or wall box; when attached to a wall by bolts it is a plate fixing. There are also beam fixings, as when wheels intended to work at the position where the fixing is situated; and when the fixing is adapted to them, it is then commonly called a wheel fixing. (2) In metallurgy, the material used in preparing the hearth of a puddling or boiling furnace for receiving its charge. It is called fettling in some parts of England. (3) In photography, of a negative; the removal, by a solution of hyposulphite of soda or cyanide of potassium, of the unaffected deposit of iodide and bromide of silver in the collodion film after exposure and development of the picture. Of a positive; the removal of the unaltered chloride of silver from the surface of the photographic paper after exposure under the negative.

Fjord. See FIORD.

Flabellum. See FANS.

Flaccus, Caius Valerius, kā'yus va-lĕ'rĭ-us flak'us, Roman poet of the latter half of the 1st century. He lived in Padua, and died young. He sung the expedition of the Argonauts in an epic poem, 'Argonautica,' of which seven books and part of the eighth have remained to us.

Flacius, flā'shĭ-us, or **Vlacich, Matthias**, māt-tē'äs flā'siH, German Lutheran theologian: b. Albona, Illyria, 1520; d. Frankfort-on-Main 1575. He became professor of the Hebrew Scriptures at Wittenberg University in 1544. From this time he took an active part in all the theological discussions of the time; and for his attacks on Melanchthon's compromise, known as the Leipsic Interim, he was, four years later, deprived of his professorship. Nor did he procure another appointment until 1557, when he became professor of theology at Jena. This post he again lost, after five years, on account of his doctrine that original sin was essentially inherent in man's nature. Of his numerous works three deserve mention: 'Clavis Scripturæ Sacræ' (1567); 'Catalogus Testium Veritatis' (1556); 'Ecclesiastica Historia' (1559–74).

Flag, a strip of cloth of a light fabric, varying in form and color, frequently bearing some emblematic design, and ordinarily fixed by one end to a staff, pole, rope, etc., while the other is allowed to fly free. The length of a flag from the part near the staff to the free end is called the fly, and the measurement at right angles to this is known as the hoist, height, or depth.

The uses of flags are numerous. They serve in a variety of ways as signals. They convey definite information of various kinds, and are used as general symbols of rejoicing, congratulation, sympathy, mourning, etc. In a classification of the uses of flags, that which stands first, as the most general, is their use as national emblems. Next in order comes their use as distinguishing emblems of the naval and military forces of particular nations. In the army each regiment is distinguished by its particular flag or colors. This usage is general, and the colors of regiments come to be distinctive of their services and of their *esprit de corps*, as well as of their position in the army. Flags are sometimes presented by persons of rank or official station, or by other individuals or groups of people, and often bear names and emblems commemorative of past achievements. In Catholic countries their consecration is a religious ceremony. This use of flags is of great antiquity. In the Bible the standards of the different tribes are referred to in the arrangement of the camp of the Israelites in the desert. The Greek and Roman armies had their distinctive flags. In the French army distinctive flags were introduced during the wars in Italy in the 16th century. The word *drapeau* in French (which, in its most extended signification is equivalent to our "flag") is used specifically for the colors of an infantry regiment; *étendard* for those of a cavalry regiment; *pavillon* for the colors used in the naval service.

The union of St. Andrew and St. Patrick marks, first the union of England and Scotland into the kingdom of Great Britain and then this kingdom with Ireland. This is the union flag of Great Britain, and was brought by the colonists to America. (See FLAG, THE AMERICAN.) Every battalion of infantry in the British army, except the Rifles, has two colors; namely, the king's color and the regimental color. The former consists, for all regiments, of the union device, with the name of the regiment in the centre and the number of the battalion on the upper part near the staff. The regimental color is of the same color as the collars and facings of the regiment; but if these are white, it bears a St. George's cross in red. On it are emblazoned the name of the regiment, the names of the battles in which it has served, and its various badges, crests, mottoes, etc. Among cavalry regiments, only the guards, dragoon guards, and dragoons have standards, as cavalry flags are termed. These are made of crimson silk, and are emblazoned like those of infantry regiments. The standards of the guards and dragoon guards are rectangular, like those of the infantry, but the dragoons carry standards with the end farthest from the staff rounded and scalloped. The lancers have red and white pennants on their lances.

The standard is the war-flag, and bears the royal or other arms of the nation. Ensigns are flags carried by ships to indicate their nationality. The place for the ensign in a steamer or large ship is on a pole over the taffrail; in schooners and similar ships, at the peak of the main gaff; in cutters and sloops, at the peak; in yawls, at the mizzen-peak; and in rowing-boats, over the stern.

Jacks are national flags used for signaling and various other purposes. Pennants or pendants are small pointed or swallow-tailed flags generally used in connection with signals. The best-known is the answering pennant used in the international signal-code. A burgee is a swallow-tailed flag used by yachts and merchant vessels, usually with the ship's name on it. Shipping companies generally have square flags with distinctive colors and devices; these are known as house-flags. A plain white flag indicates a clean bill of health, and is also used in war as the flag of truce (q.v.). The quarantine flag is yellow. Vessels carrying explosives display a red flag. A flag hoisted upside down is a signal of distress, and one borne half-mast high is a sign of mourning. Flags are often dipped in token of respect. See SIGNAL SERVICE.

Flag, The American. The colonies used the English flag, bearing first the red cross of St. George; after the union with Scotland in 1707, the «union» of St. George and St. Andrew; the present union jack, with St. Patrick's added, dates only from 1801. It was the former which Endicott cut from the flag as a popish symbol; Massachusetts petitioned for red and white roses in their place, but the military commissioners simply left out the cross and substituted the king's arms. Militia companies had sometimes their own flags. In 1686 Andros had a special one made for the New England Union. From 1700 to 1750 the New England flags were «a red or blue ensign cantoned white, with a red St. George's cross, and having a tree or globe in upper corner of the canton» (Preble); the tree is usually assumed as a pine, like that on the coins, but in neither case with any evidence. The colonial merchant ships, to distinguish them from the mother country's, had a white escutcheon in the middle of the jack. The first outbreak of special flags was at the time of the Stamp Act, when each gathering usually improvised a flag. But the «union flags» of the early Revolution times and just before seem to have been the English union jack with patriotic mottoes: the colonies kept up the theory that they were loyal subjects of England. What flag or flags, if any, were used at Bunker Hill is uncertain, as the British captured none, and the reminiscences are inconsistent. Most probably each detachment had its own and carried it off.

In the early part of the Revolutionary War there was no attempt at a national flag, each colony or even troop or privateer pleasing itself. Some of the famous ones — as Col. William Washington's at Eutaw Springs, a piece of crimson damask cut by his fiancée from her upholstered chair — were private. The public ones were mainly of two sorts. The New England type had a tree (officially made a pine) in green on a white ground, and «An Appeal to Heaven» or the Connecticut «Qui Transtulit Sustinet» as a legend; in one case, a pine and a field of Indian corn, with two wounded officers and several children, and the motto, «For posterity we bleed.» One of greater national significance was the rattlesnake type: at first cut into 13 pieces, with the initial of a colony on each, and the legend «Join, or Die»; then coiled to strike, with the legend «Don't Tread on Me»; later, 13 stripes with the snake across them. In either case, there were generally 13 rattles. Another flag was white, with a mailed hand grasping 13 arrows; still another, a female figure with a staff from which streamed 13 pennants. The first in the South was said to be devised by Col. Moultrie, in the fall of 1775 — a large blue flag with a crescent in the right upper corner, and «Liberty» in the centre; this was the one used in the defense of Fort Moultrie, and which Sergt. Jasper picked up under the British fire.

The national flag had no single or definite origin. After a few months of war it was seen to be needful, but the reluctance to break with the English pattern confirms the sincerity of the protestations of continued loyalty; and in December 1775 a committee consisting of Franklin, Thomas Lynch, and Benjamin Harrison recommended, and Congress adopted, the British union plus 13 stripes, which was hoisted over the headquarters at Cambridge, 1 or 2 Jan. 1776. The origin of the stripes is so utterly unagreed that it is probable any one of several things may have suggested it: their use on the Dutch East India Company's flags; those on the escutcheon of the Washington family; or simply the stripe which was the one distinguishing feature of the army uniform. Paul Jones claims to have been the first to raise the national flag, late in December 1775, but it seems to have been one of the rattlesnake type; that, however, was the kind selected by the Congressional naval committee on 8 Feb. 1776. In June 1776 it was unofficially decided by Congress and Washington, in view of the impending Declaration, to replace the union by a five-pointed star; but the first official adoption of a flag was on 14 June 1777, displacing the union by 13 stars, «a new constellation,» and using just 13 stripes. The first use of the new flag is disputed; it seems to have been improvised and run up over captured British standards at Fort Stanwix, 8 Aug. 1777, after the battle of Oriskany, but a regular flag was made and carried at the battle of Brandywine, 11 September. Historical paintings are full of anachronisms as to flags. The stars were generally in a circle. The first change was the addition of two new stripes and two new stars for Vermont and Kentucky, in 1794; and though Ohio and Louisiana came in, no further alteration was made for nearly a quarter of a century. The stars were generally in three lines of fives. Finally, on 4 April 1818 it was ordered that the 15 stripes be reduced permanently to 13, in memory of the original colonies, and the stars keep pace with the total number of States, on the 4th of July after each admission. The arrangement of the stars was not specified, and has been at the taste of the makers. The revenue flag has 13 blue stars on a white ground, as a union, with 16 perpendicular red and white stripes; it indicates the authority of the Treasury Department. The secretary of war, the secretary of the navy, and the President have each their flags; the latter carried at the main of naval vessels and on boats he is in. Each of the flag-officers has his own flag. The union jack, white stars on a blue ground, is used by pilots, and at the bow of ambassadors' and ministers' boats.

The Confederate States had their own flags. But at the outset of the War their Congress adopted the «Stars and Bars» — having a white stripe between two red ones, and a blue union with seven white stars in a circle, for the number of seceding States. Later the stars were increased to 13. The usual battle-flag was red, with a blue cross and white stars diagonally. Late in the War the «bars» were exchanged for a white ground next the staff and red outside; and it was sometimes made black. Consult: Preble, 'History of the Flag' (1872).

Flag Association, The American, an organization formed in the council chamber of the city hall, New York, 12 Feb. 1898, with the object of honoring the national flag and of protecting it from desecration by securing the enforcement of present laws and the enactment of others for that purpose. The association was an outcome of the Congress of National Patriotic Societies held at the same place in November 1897, and besides individual members it is composed of the members of these societies, many of which are actively represented in the association by their flag committees. In order to promote respect and love for the flag, the association encourages its proper display on private buildings, schoolhouses, churches, etc., and uses its influence to make the observance of Flag Day (June 14) a national custom.

Flag, Sweet, an aquatic, flag-like plant (*Acorus calamus*) of the natural order *Acoraceæ*, which grows in wet places throughout the northern hemisphere, and is well known for its sweetly odorous leaves and root. The leaves are sword-shaped, 3 to 6 feet long, and the spadix is lateral with bisexual flowers. The creeping, woody rhizome has long been employed in medicine as an aromatic stimulant, considered useful in ague in Great Britain, and in India as a remedy for intestinal ills among children. It is also employed in flavoring beer, and by makers of snuff and vinegar; and is chewed by singers to clear the voice.

Flag of Truce, a white flag displayed in time of war as an indication of a desire to communicate with the enemy. The flag of truce is regarded as of so sacred a character that to shoot the bearer intentionally and without warning is to place the stigma of disgrace upon the side perpetrating the act. The display of a flag of truce during active hostilities does not necessitate the cessation of firing, and accidental shooting of the bearer may be unavoidable. If he advances during an engagement, he may be denied permission to enter the enemy's lines, or he may be held. To take advantage of the protection of a flag of truce in an illegitimate way, as for instance in order to obtain information of the enemy's resources, is held to be peculiarly dishonorable. A flag of truce is not regular unless sent and received by order of the senior officers of the respective forces. During naval hostilities, a flag of truce is met by a boat in charge of a commissioned officer from the senior officer's ship.

Flagellants, flaj'e-lants (Lat. *flagellare*, to lash or scourge), a sect which arose in 1260 at Perugia, called by the French *Perouse*, and spread throughout and beyond Italy. Its adherents, said to have numbered 10,000, attempted to expiate their sins and obtain mercy by self-inflicted suffering. They ran through the cities scourging their bare shoulders and exhorting bystanders to repentance. Led by priests bearing banners and crosses, they moved in procession through the streets. They could be seen going about by night as well as by day, even in the cold of winter. They went in thousands from country to country begging alms. In 1261 they crossed the Alps in Alsatia, Bavaria, Bohemia, and Poland, and found there many imitators. In 1296 a small band of Flagellants appeared in Strasburg, who, with covered faces, whipped themselves through the city, and at every church. At first the Flagellants were noted for sanctity, and made many converts even from the most abandoned classes, but doubtful characters beginning to join their ranks, they fell into disrepute, and were restrained from their processions by the civil and ecclesiastical authorities, then the sect gradually died away. The terror produced by the dreadful disease called the black death, which destroyed many millions of people in Europe in the middle of the 14th century, produced a revival of the flagellation mania, which spread over most of Europe and was attended by greater extravagances than before. In the reign of Edward III., a band of 120 Flagellants, male and female, made their appearance in London on a missionary enterprise, but had to leave the country without having made one proselyte. In 1349 Clement VII. declared the Flagellants heretics and took steps to repress them. In 1414 an effort was made in Thuringia to revive them, under a form marked by wild fanaticism and by strange doctrines which were condemned by the Council of Constance. The burning alive of their leader, Conrad Schmidt, and 90 of his followers, partially checked the project, though the extirpation of the sect was found a work of extreme difficulty. One form of fanaticism which marked some of the Flagellants was violent hatred and persecution of Jews.

Flagellata, a group of *Protozoa*, sometimes regarded as a division of the class Infusoria, sometimes as a distinct class by itself. The group is characterized by having a body-form usually fixed and definite for the species, and by having as organs for locomotion and taking of food one or more long vibratile whip-lash-like processes, the "flagella." Like all Protozoa (q.v.) the body is composed of a single cell. The group is divided into three orders: *Autoflagellata*, *Dinoflagellata* and *Cystoflagellata*. In the Autoflagellata the body is usually oval and has both nucleus and contractile vacuole. Sometimes the body is naked and capable of amœboid motions, but usually it has a cuticle and enveloping cases are not uncommon. In one sub-order (*Choanoflagellata*) a peculiar collar-like structure is developed around the flagellum. Some of the group closely approximate plants, some forms like Euglena and Volvox being claimed by the botanist. A few are human parasites. The Dinoflagellata have a firm external armor of hard cellulose plates, divided by a groove around the body, and with a second longitudinal groove. At the junction of the two grooves are the two flagella, one lying in the circular groove, the other projecting freely. These forms occur in salt and fresh water. In the Cystoflagellata the large gelatinous body is enclosed in a stout membrane. The best-known form is Noctiluca (q.v.), noted for its phosphorescent powers.

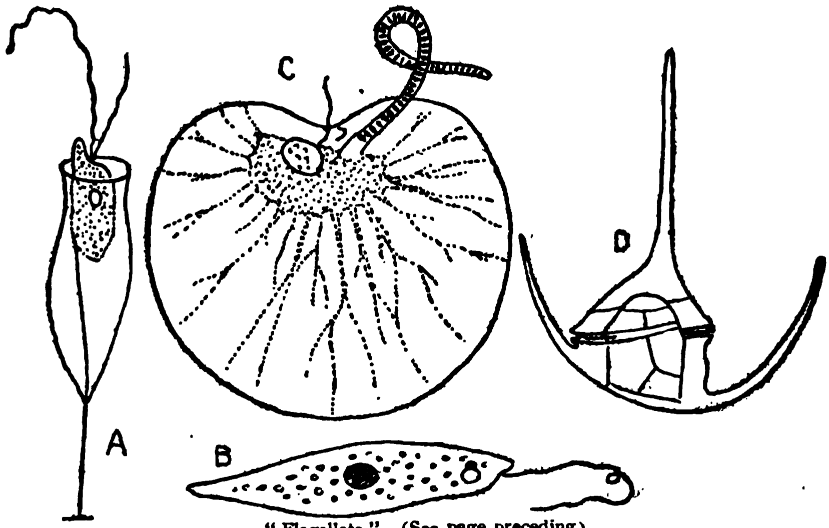
Flagella'tion, scourging or whipping, either self-inflicted or administered by another person, especially as a religious practice. Its application as a means of religious penance is an old Oriental custom, admitted into Christianity partly because self-torment was considered salutary as mortifying the flesh, and partly because both Christ and the apostles underwent scourging. From the 1st century of Christianity religious persons sought to atone for their sins by voluntary bodily torture. Like the Abbot

Regino, at Prum, in the 10th century, many tried to imitate the sufferings of Christ, in order to make themselves the more certain of forgiveness through him. It became general in the 11th century, when Peter Damiani of Ravenna, abbot of the Benedictine monastery of Santa Croce d'Avellano, near Gubbio, in Italy, afterward cardinal bishop of Ostia, zealously recommended scourging as an atonement for sin, to Christians generally, and, in particular, to the monks. His own example and the fame of his sanctity rendered his exhortations effective. Clergy and laity, men and women, began to torture themselves with rods, and thongs, and chains. They fixed certain times for the infliction of this discipline upon themselves. Princes caused themselves to be scourged naked by their father confessors. Louis IX. constantly carried with him for this purpose an ivory box, containing five small iron chains, and exhorted his father confessor to scourge him with severity. He likewise gave similar boxes to the princes and princesses of his house, and to other pious friends, as marks of his peculiar favor.

The expectation of being purified from sin by flagellation prevailed throughout Europe in the last half of the 13th century. «About this time,» says the monk of Padua in his chronicles of the year 1260, «when all Italy was filled with vice, the Perugians suddenly entered upon a course never before thought of; after them the Romans, and at length all Italy. Men of noble and ignoble birth, old and young, traversed the streets of the city naked, yet without shame. Each carried a scourge in his hand, with which he drew forth blood from his tortured body, amidst sighs and tears, singing at the same time penitential psalms.» The penitents united into fraternities called the Flagellants (q.v.). After the Council of Constance (1414–18) both clergy and laity gradually abandoned flagellation. The Franciscan monks in France (Cordeliers) observed the practice longest.

Flagellation was sometimes voluntary and sometimes imposed as a penance. Henry II. of England allowed himself to be scourged at the tomb of Thomas à Becket (q.v.). In its theological aspect flagellation has no especial merit in itself and is classed merely as a form of penance or self-mortification. It is meritorious only as a means of expiation of sins repented for and absolved, or as a method of mortification of the flesh for the suppression and control of the passions. Any excess in it is prohibited. See FLOGGING; PENANCE; WHIPPING POST.

Flageolet, flaj'ō-let, a small wind-instrument, the notes of which are exceedingly clear and shrill. It is a sort of whistle with a mouthpiece that is usually inserted in a bulb. It is generally made of box or other hard wood, though sometimes of ivory, and has six holes for the regulation of its sounds, besides those at the bottom and mouthpiece, and that behind the neck. Its compass is two octaves, and a set of five different sizes is needed to take all the semitones in this range. It was formerly used in the orchestra.



" Flagellata." (See page preceding)

Various Flagellata. A, Bicoseca; B, Englina vividis (Autoflagellatis); C, Noctiluca miliaris (Cystoflagellate); D, Ceratium tripos (Dinoflagellate).

Flaget, flā-zhā, **Benedict Joseph,** American Roman Catholic bishop: b. Contournat Angergne, France, 7 Nov. 1763; d. Nazareth, Ky., 11 Feb. 1850. He was educated in France, came to America, and was made bishop of Bardstown in 1810. The name of his diocese was subsequently changed and he became bishop of Louisville in 1841.

Flagg, George Whiting, American artist: b. New Haven, Conn., 26 June 1816; d. Nantucket, Mass., 5 Jan. 1897. He studied art for six years in London, England, and on his return to the United States opened a studio in New York. He was elected a member of the National Academy of Design in 1843, and an academician in 1851. Among his best-known paintings are: 'Landing of the Pilgrims'; 'Washington Receiving His Mother's Blessing'; 'The Good Samaritan'; 'The Scarlet Letter'; and 'The Execution of Lady Jane Grey.'

Flagg, Isaac, American Greek scholar: b. Beverly, Mass., 7 Sept. 1843. He is a son of Wilson Flagg (q.v.) and was graduated from

Harvard 1864. He was professor of Greek at Cornell University 1871–88, and at the University of California since 1899, holding at the latter institution the chair of classical philology 1890–9. He is the author of ‘Versicles’; ‘Outlines of the Temporal and Model Principles of Attic Prose’; and has edited: ‘The Hellenic Orations of Demosthenes’; ‘The Seven Against Thebes, of Æschylus’; etc.

Flagg, Jared Bradley, American Episcopal clergyman and artist: b. New Haven, Conn., 1820; d. 1899. He studied art with his brother G. W. Flagg (q.v.), entered the Episcopal ministry in 1854 and was for several years rector of Grace Church, Brooklyn Heights, N. Y. He was especially noted for the excellence of his portraits. He published ‘Life and Letters of Washington Allston’ (1892).

Flagg, Wilson, American naturalist: b. Beverly, Mass., 5 Nov. 1805; d. Cambridge, Mass., 6 May 1884. He published: ‘Studies in the Field and Forest’ (1857); ‘Halcyon Days’; ‘A Year Among the Trees’ (1881); and ‘A Year Among the Birds.’

Flag'ler, Henry M., American capitalist: b. Canandaigua, N. Y., 1830. He began life as a clerk in a country store, then going to Saginaw, Mich., he became a salt manufacturer. He afterward removed to Cleveland, Ohio, and formed one of the firm of Rockefeller, Andrews and Flagler, now known as the Standard Oil Company, and with which he is still connected. He is the proprietor of some 600 miles of railroad in Florida and of the Ponce de Leon and Alcazar hotels at Saint Augustine.

Flagler, Isaac Van Vleck, American organist: b. Albany, N. Y., 15 May 1842. He studied at Paris under Batiste, and has since become famous as a church organist in the United States, being at present organist of the First Presbyterian Church, Auburn, N. Y. He has composed, among many organ pieces, ‘Variations on an American Air.’

Flag'staff, Arizona, an important railroad town in Coconino County, on the Atchison, T. & S. F. R.R. It has an altitude of 6,935 feet. The town has extensive live-stock and lumber interests. Tourists going to the Grand Cañon of the Colorado make Flagstaff their base of supplies. Pop. 1,700.

Flambard, flam'bärd, **Ranulph** or **Ralph,** Norman prelate and statesman, d. 5 Sept. 1128. He was early connected with the Conqueror's court, and being handsome, clever, and unscrupulous, gained great influence with the king, and rose to still greater favor with Rufus, whom he encouraged in his tyrannical and rapacious courses. His flagrant extortions earned the hatred of the people, and his character is painted in the blackest characters by the chroniclers. In 1099 he was made Bishop of Durham; but on the death of Rufus he was committed to the Tower by Henry I. He managed to escape, however, by means of a rope conveyed to him in a vessel of wine, and instigated Robert, Duke of Normandy, to invade England. He was subsequently forgiven by Henry and restored to Durham, where he engaged in architectural works connected with the city and the cathedral. See Freeman, ‘The Norman Conquest,’ Vols. IV. and V.; Freeman, ‘William Rufus.’

Flamborough (flam'bur-ō) **Head,** a bold promontory of England, on the Yorkshire coast, projecting a considerable distance into the sea; lat. 54° 7′ N.; lon. 0° 5′ W. This is at once the most striking and most celebrated headland on the east coast of Great Britain, rising 450 feet sheer above the sea, having on its summit a lighthouse, 214 feet high, showing a revolving light which is visible 21 miles. Vast caverns, haunted by myriads of sea-fowl, penetrate deeply through this headland. For the battle of Flamborough Head, see Jones, Paul.

Flamboy'ant, a term applied to the decorated and very ornamental style of architecture of French origin, and employed in France contemporaneously with the Perpendicular style in England. One of the most striking and common features is the waving and somewhat flame-like arrangements of the tracery of the windows, panels, etc. The Church of St. Maclou, Rouen, erected 1432–1500, is said to be one of the finest specimens of this style.

Flame, any gas or gaseous mixture that is actively undergoing combustion. Solid bodies (such as coke) which do not contain volatile constituents become incandescent when they burn, but their combustion is not attended by the development of actual flame. The flames that appear to issue from such solid combustibles as wood and coal are in reality due to the combustion of gases that are distilled from the fuel by the intense heat, as may be very easily proved by subjecting these bodies to the same temperature in closed vessels which prevent the access of air. Abundant quantities of combustible gases are then given off, and these may be led away in pipes, or stored in tanks, to be burned at more convenient times or places. The gas that is obtained from coal in this way has been used for many years for purposes of illumination. The mixed gases that are evolved when wood is subjected to destructive distillation contain methyl alcohol, acetic acid, and many other organic substances; and in fact they constitute the chief commercial source of the two substances just named. (See Alcohol.) Flames are usually very hot and luminous, though in some cases there is but little light developed. The flame of a spirit lamp, for example, is barely visible, although it is intensely hot; and the flame of burning hydrogen is an even more striking case of the same sort. The luminosity of flames is due chiefly to the incandescence of tiny particles of solid carbonaceous matter that they hold in suspension, as has been proved by many ingenious experiments. When a piece of wire gauze is brought down over the flame of a candle, the gauze permits the gases that arise from the wick to pass through it, but it chills them so that they are no longer capable of combining with one another, and hence the flame does not extend above the gauze. This simple and instructive experiment enables the observer to examine the structure of the candle flame without the least difficulty, and shows it to be a hollow cone, burning only on the outside, where the oxygen of the air can mingle with the gases in sufficient quantities to support combustion. That the gases developed at the wick really do rise up through the gauze is easily proved by igniting them with a burning match. Flames may be colored, and often very brilliantly, by the presence within them of certain metallic salts. Thus sodium compounds produce a strong orange-yellow color, potassium a violet, and strontium a crimson. Advantage is taken of this fact for the production of gorgeous color effects in pyrotechny. In chemical analysis, too, the color that a given substance yields when placed in a hot but normally non-luminous flame often gives valuable information concerning its composition. See Blow-pipe Analysis; Spectroscope.

Flame-flower. See Tritoma.

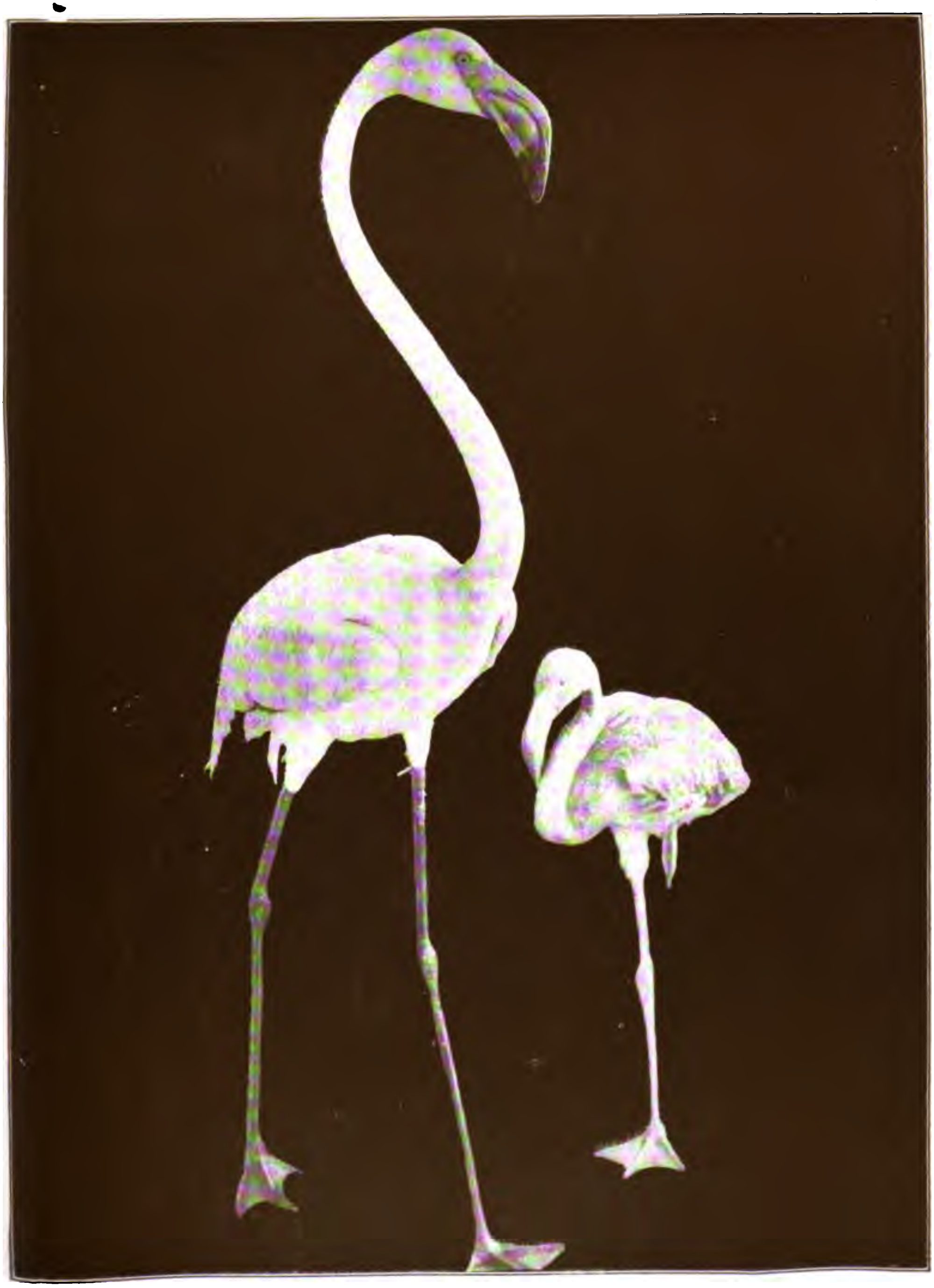
Flameless Explosives, explosives containing ammonium nitrate, with or without ammonium oxalate, which are to be used in blasting in mines containing fire damp or combustible dust. As examples of such explosives we have «ammonite,» consisting of ammonium nitrate 87 to 89 per cent, and dinitronaphthalene 13 to 11 per cent; «amvis,» ammonium nitrate 88 to 91 per cent, dinitrobenzene and chloronaphthalene 4 to 6 per cent, and wood pulp 4 to 6 per cent; «bellite,» ammonium nitrate 82 to 85 per cent, and metadinitrobenzene 18 to 15 per cent; «benedite,» ammonium nitrate 93 to 95 per cent, and rosin 7 to 5 per cent; «Casteaux's explosive,» ammonium nitrate 90 per cent, nitrodextrine 10 per cent; «grisoutine,» ammonium nitrate 67 per cent, nitroglycerin 30 per cent, and nitrocotton 3 per cent; «nitroferrite,» ammonium nitrate 93 to 94 per cent, potassium forrocyanide 2 per cent, crystallized sugar 3 to 2 per cent, and «trinitronaphthalene» 2 per cent; «progressite,» ammonium nitrate 94 to 95 per cent, and aniline chlorhydrate 6 to 5 per cent, and «roburite,» ammonium nitrate 90 per cent, chlorodinitrobenzene 10 per cent.

Flamen, flā'men, a priest of ancient Rome consecrated to the service of a particular divinity. They were established by Numa and were at first three in number: *flamen Dialis*, the priest of Jupeter; *flamen Martialis*, the priest of Mars, and *flamen Quirinalis*, the priest of Romulus. These three constituted the *flamen majores*, and were always of the patrician class. Later twelve *flamen minores* were created, chosen from the plebeians. The *flamines* held office for life, but were removable for neglect of duty or contamination, and were required to resign and remain single upon the death of their wives, the *flaminica*, who assisted them in their duties and were governed by the same rules as their husbands. The *flamen* was distinguished by the *apex*, a conical cap in the top of which was fastened a pointed twig of olive wood bound at its base with a lock of wool. He was not required to take an oath, was an ex-officio member of the Senate, was entitled to the use of the *toga prætexta* and the curule chair. He was entitled to the assistance of a lictor, and for himself and for his house held the right of sanctuary and of pardon. He could not leave the city for a single night or sleep out of his own bed for three consecutive nights, mount or touch a horse, touch a dead body, or engage in a long list of occupations that were considered to contaminate him. The flamens were selected by the Pontifex Maximus from three candidates nominated by the pontifices. When the emperors were deified they had flamens, as the *flamen Augusti*. There were also *flamines curiales*, and a *flamen arvalium*. Consult Marquart, 'Romische Staatsverwaltung' (1885).

Flameng, Francois, frän-swä flä-män, French painter: b. Paris 1859. He began his art studies under his father, Leopold Flameng, the engraver, and studied subsequently under Cabanel, Hedouin and Jean Paul Laurens. He is an artist of distinguished ability as a figure painter, and among the most striking works of his are: 'The Girondins Summoned' (1879); 'The Bowlers' 1886); and 'Grolier and Alus,' which last hangs in the Grolier Club of New York.

Flamingo, flä-ming'gō, a peculiar web-footed bird of the group *Phœnicopteri*, which may be regarded as intermediate between the storks and the ducks, the long legs and necks giving it a resemblance to the former, while the webbed feet connect it with the latter. There are six species of true flamingoes, widely spread over the warmer regions of both hemispheres. Our North American species (*Phœnicopterus ruber*), once common all along the southern shores of the United States, but now almost exterminated even from Florida, and ranging southward to the Argentine Republic, is light vermilion with brighter wing coverts. The other forms are rosy white (scarlet on the wing coverts) with black wing-quills. All have small goose-like bodies, but the long legs and neck give them a height of four or five feet. Their most extraordinary part is the bill, which is large, swollen and bent upon itself so that the upper half is turned downward when the bird feeds, with its head twisted and crown downward. The edges of both upper and lower jaw are furnished with small transverse plates, which serve, as in ducks, for a sieve, allowing the escape of the mud, but retaining the small worms, crustaceans, mollusks, fishes, etc., on which the birds feed. The upper surface of the tongue is beset on the sides and base with flexible, recurved, horny spines. Flamingoes live and migrate in large flocks, warning one another of danger by a loud trumpeting note, which is the signal for the flock to take wing. When flying, they form a triangle.

They breed in companies in mud-flats or inundated marshes, where they spend most of their time wading about, raising up the mud into a small hillock, which is concave at the top so as to form a nest. In this hollow the female lays her one egg, and hatches it by sitting with her legs doubled up under her. The young, usually two in number, do not fly till they have nearly attained their full growth, though they can run very swiftly and swim with ease almost immediately after their exclusion from the shell. This bird was held in high repute among the luxurious Romans; and Apicius, so famous in the annals of gastronomy, is recorded by Pliny to have discovered the exquisite relish of the flamingo's tongue, and a superior mode of dressing it. When taken young they soon grow familiar, but they are not generally found to thrive in the domesticated state. The European flamingo (*P. roseus*) is abundant in marshy regions of Spain and southern France, and is found as far south as Cape Colony, and as far east as Lake Baikal. In northwestern India it may be seen in flocks numbering tens of thousands. Another very similar species (*P. minor*), but of less size and with the chin feathered, is found from Madagascar around the whole circuit of the shores of the Indian Ocean. Three



FLAMINGO (*Phœnicopterus antiquorum*).

From a Photograph provided by the American Museum of Natural History

other species are known in South America, *P. andinus* of the central Andes, the largest of the family; *P. jamesi,* of southern Peru and Chile, and *P. chilensis* of the region south of Brazil, which has greenish shanks. In addition to the various ornithologies, the reader may consult an article by H. A. Blake, 'Nineteenth Century' (December 1887); Chapman and Buck, 'Wild Spain' (1893); and F. M. Chapman, 'Bird Lore' (1902).

Flaminian (flā-min'i-an) **Way,** the northern road which led from ancient Rome. It was constructed by Gaius Flaminius the elder in 202 B.C. during his censorship, and led from Rome to Ariminum (Rimini) on the Adriatic, 222 miles. Remains of it are yet extant in various places.

Flamininus, Titus Quintius, tī'tus kwin'-shi-us flam-ĭ-nī'nus, Roman general: b. about 230 B.C.; d. about 175. Elected consul in 198, he undertook the conduct of the war against Philip II. of Macedon. By pretending that his object was to remove from Greece the Macedonian yoke, he detached many of the Greek states from Philip, and defeated him at Cynoscephalæ (197) in Thessaly. By the treaty soon after concluded Philip surrendered all the Greek towns which he possessed in Europe and Asia, and paid a heavy contribution to the Romans. At the Isthmian games in 196 Flamininus proclaimed, to the great joy of the assembled Greeks, the freedom of those states which had been subdued by Macedon. In 195 he diminished the power of the tyrant Nabis of Sparta, after which he occupied himself in restoring internal peace and prosperity to Greece.

Flaminius, Gaius, ka'yus flā-min'i-us, Roman general: d. 23 June 217 B.C. He was tribune of the people in 232, consul in 223 and 217, and censor in 220. As tribune he carried against the opposition of the senate an agrarian law. In his first consulship he with his colleague attacked the Gauls beyond the Po, and was defeated. The senate then recalled the consuls, but Flaminius resisted the order by refusing to open the letter, and obtained a victory over the Insubrians. A triumph was refused him on his return, but he was rewarded with demonstrations of popular favor. The circus Flaminius and via Flaminia were the monuments of his censorship. In his second consulship he marched against Hannibal, and rashly giving battle, was slain near Lake Thrasymenas.

Flammarion, Camille, kä-mēl flä-mä-rē-ôṅ, French writer on astronomy: b. Montigny-le-Roi (Haute-Marne), 26 Feb. 1842. In 1858 he entered the Paris observatory as pupil, being transferred in 1862 to the Bureau des Longitudes, where he remained till 1866. Although still a youth, he had already published the first of his many works, namely: 'La Pluralité des Mondes habités' (1862; 36th ed. 1892); 'Les Mondes imaginaires et les Mondes réels' (1865; 21st ed. 1892); and 'Les Merveilles Célestes' (1866; 7th ed. 1881). For five years from about 1868 he made a study of the upper regions of the atmosphere during several balloon ascents. In 1882 he founded the monthly magazine 'L'Astronomie,' and in 1887 started the French Astronomical Society. M. Flammarion has gained considerable fame for original researches in astronomy, especially in connection with double and multiple stars, colors of stars, sun-spots, and the proper motion of the stars; but is much better known for his excellent, well-written and accurate popular hand-books. Among his other works are: 'Etudes et Lectures sur l'Astronomie' (1867–80); 'Dieu dans la Nature' (1867; 22d ed. 1892); 'Lumen' (1872; 40th ed. 1890); 'Voyages en Ballon' (1870; 20th ed. 1889); 'Vie de Copernic' (1872); 'L'Atmosphère' (1872); 'Histoire du Ciel' (1873); 'Petite Astronomie' (1877); 'Les Terres du Ciel' (1877); 'François Arago' (1879); 'Astronomie Populaire' (1880); 'Les Etoiles et les Curiosités du Ciel' (1881); 'Le Monde avant la Création de l'Homme' (1886); 'Les Tremblements de Terre' (1886); 'Uranie' (1889); 'Qu'est-ce que le Ciel' (1891); 'La Planète Mars et ses Conditions d'Habitabilité' (1893). Several books have been translated into English.

Flam'steed, John, English astronomer: b. Denby, near Derby, 19 Aug. 1646; d. Greenwich 31 Dec. 1719. He began his mathematical and astronomical studies at an early age, and in 1675 took orders in the Established Church. He still continued his astronomical observations, and was in constant correspondence with scientific men. He found the astronomical tables of the day to contain large errors, and was anxious to make more detailed and accurate observations. This having come to the knowledge of Charles II., he was appointed astronomical observer to the king, and carried on his observations at the Queen's House at Greenwich, until the observatory was built for him in 1676. Here he passed the remainder of his life amidst his astronomical labors, which are considered as the foundation of modern practical astronomy. He was so ill supported that he had to teach for his own support, and erect instruments at his own expense. In 1684 he was presented with a small living, and his father dying in the same year, he was enabled to provide some needful apparatus at his own expense, which, on his death, was claimed by the government as public property.

Flan'ders, Henry, American lawyer: b. Sullivan County, N. H., 13 Feb. 1826. He studied law and since 1850 has practised his profession in Philadelphia. He has published: 'Maritime Law' (1852); 'The Law of Shipping' (1853); 'Lives of the United States Chief Justices' (1855–8); 'An Exposition of the Constitution of the United States' (1869); 'Law of Fire Insurance'; 'Adventures of a Virginian.'

Flanders (French, *Flandre;* German and Flemish, *Flandern;* Dutch, *Vlaanderen*), a former country or district of Europe, now included in Holland, Belgium, and France. It stretched from the Schelde, below Fort Lillo, west along the Hond, or West Schelde, and west-southwest along the German Ocean to the entrance of the Straits of Dover, near Gravelines, and was bounded east by the duchy of Brabant, south by Hainaut, and west by the French provinces of Artois and Picardy. The origin of the name is unknown. It occurs for the first time, but in a very restricted sense, in the 7th century. The erection of the territory into a county took place in the 9th century, and was made by Philip the Bold, king of France, in favor of his son-in-law, Baldwin, of the Iron Arm. It afterward passed to the united houses of Spain and Austria, and ultimately to the latter, but underwent considerable curtailment by the conquests of the French in the west, when part of it became French Flanders, and is now included in departments Nord and Ardennes; and by the conquests of the Dutch in the north, who succeeded in including the most northerly portion of it in the province of Zeeland. The remainder still retains its ancient name, and forms the modern provinces of East and West Flanders, in Belgium (q.v.).

Flanders, East (Fr. *Flandre Orientale*), a province of Belgium, bounded north by Holland, east by the provinces of Antwerp and Brabant, south by Hainaut, and west by West Flanders; length, north to south, 34 miles; central breadth, east to west, 32 miles; area, 1,158 square miles. The surface forms an extensive plain, sloping gently eastward. It wholly belongs to the basin of the Schelde, which by itself, its tributaries, and canals connected with them, furnishes ample water communication. Its soil, partly of a sandy and partly of a clayey nature, is so industriously and skilfully cultivated that it has the appearance of a vast garden, and presents one of the richest rural landscapes which anywhere exists. The principal crops are wheat and flax, but almost all the plants which can be grown under the same latitude are cultivated with success. There are no forests properly so called, but owing to the general practice of planting hedge-row trees, there is no want of wood. In general, however, it consists of poplar and other soft-wood trees, and makes only indifferent timber. There are no minerals of any value, but manufactures have made great progress, and all the ordinary, as well as the fine tissues of wool, cotton, and flax, are well and largely made. There are also numerous tanneries, breweries, distilleries, soap-works, roperies, sugar and salt refineries, etc. The trade includes, in addition to these articles, flax, hops, and oil. For administrative purposes the province is divided into six arrondissements — Gand, or Ghent, the capital; Alost, Audenarde, Termonde, St. Nicolas, and Eecloo. Pop. about 1,030,000.

Flanders, West (Fr. *Flandre Occidentale*), a province of Belgium, bounded north and northwest by the German Ocean, west-southwest and south by France, southeast by the province of Hainaut, east by East Flanders, and northeast by Holland; greatest length, north-northeast to south-southwest, 54 miles; greatest breadth, 48 miles; area, 1,249 square miles. The surface is generally flat, but a few low hills occur in the south and east, and a range of sand hills or downs lines the greater part of the coast. The most important crops are flax, both abundant in quantity and excellent in quality; oats, barley, hops, oil-seeds, tobacco, madder, and chicory. The cattle, of all sorts, are of excellent breeds; and fish, poultry, and game abound. The most important branch of industry is linen, ordinary and damask. Great quantities of lace also are made, and there are numerous breweries, distilleries, tanneries, dye-works, oil-works, soap-works, salt and sugar refineries, etc. The province is divided into eight arrondissements — Bruges (the capital), Courtrai, Ypres, Furnes, Thielt, Roulers, Ostend, and Dixmude. Pop. about 806,000.

Flandin, Eugène Napoléon, nä-pō-lā-ôṅ ė-jen fläṅ-dăṅ, Italian painter and archæologist: b. Naples, Italy, 15 Aug. 1809; d. Tours, France, 1876. He published: 'Études sur la Sculpture Perse' (1842); 'Etudes sur la Perse moderne' (1842); 'Relation du voyage in Perse' (1843). In 1843–5 he traveled with Botta through the country of the Tigris, and illustrated his fellow traveler's 'Monuments de Ninive,' with drawings of the sculptures of Khorsabad. He finally made a full artistic exposition of Oriental life in his elaborately illustrated work, 'L'Orient' (1856); and also wrote 'Histoire de chevaliers de Rhodes' (1854).

Flan'drau, Charles Macomb, American writer of fiction: b. Minnesota 1870. He is the author of 'Harvard Episodes'; 'The Diary of a Freshman.'

Flan'drians, or Flemings, a subdivision of the Mennonite Anabaptist sect. They arose in the 16th century, and were rigid in their procedure. In 1630 A.D. the majority of them entered into a union, confirmed in 1649, with their more moderate brethren, who were often called Waterlanders.

Flandrin, Jean Hippolyte, zhoṅ ē-pō-lēt fläṅ-drăṅ, French historical and portrait painter: b. Lyons 23 May 1809; d. Rome, Italy, 21 March 1864. He worked under Ingres, and from him he imbibed that love of severe and definite form and that classical feeling which he used for his own ends in his religious painting. In 1832 he won the Prix de Rome by his 'Recognition of Theseus'; and before his five years' residence in Italy was completed he had produced his 'St. Clair Healing the Blind,' now in the cathedral of Nantes. Henceforward he was mainly occupied with decorative monumental work, though he also executed many admirable portraits. In 1842 he began his great frescoes of 'Christ Entering Jerusalem,' and 'Christ Going up to Calvary,' in the sanctuary of the Church of St. Germain-des-Près, Paris, deeply impressive works, which already entitled their painter to rank as the greatest religious painter of the century. The choir of the same church he adorned (1846–8) with figures of the Saints and the Virtues. He also decorated the Church of St. Paul at Nîmes (1847–9), the Church of St. Martin d'Ainay at Lyons (1855), and painted the frieze of St. Vincent de Paul, in Paris, with a noble series of saints and martyrs. In 1855 he began his last great work in the nave of St. Germain-des-Près, consisting of subjects from the Old and New Testaments, of which some were left uncompleted at his death, at Rome, 21 March 1864. His 'Lettres et Pensées,' with a memoir and a catalogue of his works, were issued 1865. See 'Lives,' by Poncet (1864); 'Montrard' (1876).

Flandrin, Jean Paul, zhoṅ pōl, French painter: b. Lyons 8 May 1811; brother of the portrait and historical painter Hippolyte Flandrin (q.v.), and a landscape painter whose compositions are of an ideal character and represent a survival of the classical school of Poussin and Claude.

Flan'nan or Flan'nen Islands, or The Seven Hunters, a group of small rocky islands in Scotland, in the Outer Hebrides, included in the county of Ross and Cromarty, about 15 miles west-northwest of Gallon Head. They are frequented by large numbers of seabirds, and sheep used to be pastured on some of them. There is a lighthouse of recent erection, standing at a height of over 200 feet, the structure itself being 75 feet high, with a light visible 24 miles.

Flannel, a woolen fabric of more or less loose texture and various degrees of fineness, much used as an article of clothing both in hot and cold countries, and for outer as well as inner garments, being very commonly worn next the skin. Flannel made in Wales from the wool of the native mountain sheep has the highest reputation.

Flannel-mouth, a local name for the great Mississippi catfish (*Ameiurus lacustris*). (See CATFISH.) Another fish, one of the suckers (*Catostomus latipinnis*) is so called in the neighborhood of the Rio Colorado.

Flannen Islands. See FLANNAN ISLANDS.

Flash, Henry Lynden, American author: b. Cincinnati, Ohio, 20 Jan. 1835. He served during the Civil War as volunteer aide on the staffs of the Confederate Gens. Hardee and Wheeler; and later edited the ‹Telegraph› and ‹Confederate› in Macon, Ga. He was the author of ‹Poems,› and of many popular ballads which appeared during the Civil War.

Flashlight, Electric. See FOG SIGNALS.

Flat Foot, or Pes Planus, a very common deformity of the foot due to a loss of the natural arch. A strong ligament holds the os-calcis and astragalus in such a position that an arch is formed by the bones of the foot and the weight of the body is transmitted through that arch. There is a congenital variety that is said to be due to lack of the normal fatty pad in the hollow of the new born infant's foot. During the first five years of life this fatty pad takes the place of the bony arch and if the pad be lacking the arch does not develop. The acquired variety affects those suddenly called upon to stand for long hours upon the feet. A very large number of nurses and soldiers and policemen suffer more or less with this deformity in their early months of training. Rickets, knock-knees, sprains and badly set fractures of the leg may give rise to flattening of the arch.

The bones are not changed from their normal shape except in the very young, but their relation to each other is altered. There is also a stretching of the extensor tendons of the foot and the muscles and fascia of the sole. Besides the flattening of the foot there is a more or less marked turning out of the toes and a tendency to walk on the inner side of the foot. This gait becomes quite characteristic.

In the acute cases particularly there is apt to be severe pain in the spring ligament, the inner malleolus or the ball of the great toe. Because of this, the affection is very commonly thought to be rheumatism, gout, or disease of the bone.

The normal marking of the sole of the foot is an impression of the heel, a narrow margin of the outside of the foot and a broad line made by the ball of the foot. When the arch becomes weakened there is a gradual increase of the outer margin until almost the whole foot makes its impression. This simple test is of great value.

Congenital flat foot may be greatly improved if discovered in time by manipulative massage, bandaging and the use of supports until the bony arch is formed. Acute cases of flat foot in adults sometimes require rest for a time. Properly made shoes without braces frequently suffice to prevent a return of the trouble. Others require the constant use of felt or well-adjusted steel springs in the shoes. Exercises of the extensors of the foot, massage and electricity are of value.

The bad cases of deformity that cannot be corrected require operation under an anæsthetic, the joints being forcibly freed and kept in normal position by plaster cast for a period and then kept up by a support.

Flatbush, New York, formerly a town in Kings County, Long Island, but since 1900, a part of the borough of Brooklyn, New York. Before being incorporated in the city Flatbush had a population of 15,620. The locality is of considerable historic interest, having been the scene of a part of the battle of Long Island, 27 Aug. 1776.

Flatfish, a fish of the *Heteromomata*, including the families *Pleuronectidæ* and *Soleidæ*, which are characterized by their greatly compressed form, distorted skulls and the habit of lying and moving on the side. They are somewhat related to the cod family, and inhabit the seas of all parts of the world, more than 500 species, classified in some 55 genera, being known to ichthyologists. All are oval or elliptical in outline, very thin and flexible, and habitually rest, half covered, or move sidewise along sandy sea-bottoms, some species near shore, or even ascending rivers, others only in deep water. They are carnivorous, taking as food mainly mollusks, worms, sand-dollars and the like, found in such places, for the crushing of whose shells they are provided with strong teeth, chiefly developed on the inferior side of the mouth. The flatness of these fishes is not a broadening laterally but a compression of the body whereby they become high and thin in a dorso-ventral direction, lie over on one side (usually the left), and have the head permanently twisted to the side uppermost in their customary position. This, however, comes about only with age. The very young flatfish are born in the normal shape of fishes, and swim in the ordinary vertical position, but soon begin to assume the adult peculiarities. This tendency causes profound changes in structure. The skull gradually becomes so distorted that its facial part is twisted at right angles to the plane of the cranial part, and both eyes, set close together, look upward, so that the fish has a seeing and a blind side. In order to get into this position the eye of the under side is rotated around, or in some species right through the young skull, when the fry is only an inch or so in length and the bones not yet ossified. The curious condition of the dorsal fin in the flatfish is nevertheless a greater mark of distinction. The external ethmoid bone belonging to the blind side is much enlarged, and sends back a process outside the eye belonging to that side to meet another process from the cranial region of the skull. Thus, says Cunningham, the eye which has migrated is enclosed in a complete bony orbit, while the other (lower) eye is merely bounded on its outer side by the jaw muscles. It is on this bony bridge entirely foreign to the anatomy of an ordinary fish that the dorsal fin is supported, and is able to extend from the tail clear to the snout, not passing between the eyes, but separating the hidden from the exposed side. Similarly the ventral and anal fins form a continuous growth along the ventral keel, defining there the upper side from the lower. The lesser forward fins, like the mouth, are usually asymmetrical. They are able to swim well when they please, and sometimes appear at the surface, progressing with a curious sideways undulatory movement very graceful. This is a dangerous excursion, however, and flatfish as a rule cling to the bottom, trusting to be overlooked because of their close resemblance to the sand or mud.

The young flounder or other species is brown on both sides alike; but when it turns on one side and lies flat, the under side becomes nearly white while the upper assumes the color of the bottom upon which the fish habitually rests. This is an excellent example of protective resemblance. (See COLORATION, PROTECTIVE); and that it arises from the habits of the fish and is the effect of persistently keeping the under side in shadow, is plain from the fact, demonstrated by experiment, that when flatfish are confined in aquaria with glass bottoms, through which light is reflected upon the under side, color will develop there. Some flatfish are spotted, increasing their likeness to a pebbly bottom. All these circumstances make it evident that flatfishes originated from symmetrical ancestors related to those of the cod, but what were the inducing causes of the extraordinary changes that have characterized their evolution are not plain. Little help is derivable from palæontology for fossil flatfishes are extremely rare, the oldest known being a sole-like form from the Upper Eocene of southern Europe.

The group includes two families, the flounders (*Pleuronectidæ*) and the soles (*Soleidæ*). Jordan subdivides the former into three sections, namely *Hippoglossinæ*, halibut tribe; *Pleuronectinæ*, flounder tribe; and *Psettinæ*, turbot tribe. The soles are a small family distinguished by the hidden, adnate character of the gill-cover, the small, much twisted eyes and mouth, and the absence of teeth. The whole group yields excellent flesh, and furnishes some of the most important food-fishes of commerce as well as several regarded as especial delicacies. They are treated of at length in Goode's 'Fishery Industries,' Sec. 1 (1884); and in Jordan and Evermann's 'Fishes of North and Middle America' (1898). See FLOUNDER; FLUKE; HALIBUT; PLAICE; SOLE; TONGUE-FISH; TURBOT; WINDOW-PANE.

Flathe, Heinrich Theodor, hīn'riH tā'ō-dōr flä'tĕ, German historian: b. Tanneberg, near Nossen, Germany, 1 June 1827. He attended the Fürstenschule in Meissen, studied philology and history in Leipsic and in 1867 was appointed teacher in the Fürstenschule at Meissen. His main achievement was the revision and rearrangement of F. W. Bottiger's 'Geschichte des Kurstaats und Königreichs Sachsen' (1867), which he transformed into a new work, for he not merely added new details, but rewrote much of the main argument. He has also among other works written 'Allegemeine Weltgeschichte' (1883).

Flathead, or (properly) **Salish Indians,** a tribe of Indians with uncompressed skulls, as distinguished from the "peaked-heads" who did compress their skulls, and who gave the others the name of Flatheads. These Flatheads are a superior tribe, originally dwelling around the Flathead Lake and River in northwestern Montana; much respected by the traders and explorers as at once very brave against their enemies (chiefly the Blackfeet) and honorably requiting friendly treatment. The famous Flathead mission, the most successful in the Northwest, was established among them in 1841 by the Jesuit missionary P. J. De Smet. They are now located on the Jocko reservation in their old territory, confederated with the Pend d'Oreilles and joined with the Kootenais, the whole numbering 1,280.

Flather, John Joseph, American mechanical engineer: b. Philadelphia, Pa., 9 June 1862. He was graduated from the Sheffield Scientific School of Yale, and after several years' experience in American and foreign machine shops was instructor in mechanical engineering at Lehigh University 1888–91; professor of the same at Purdue University 1891–8; and he has filled a similar post at the University of Minnesota from 1898. He has published: 'Treatise on Steam Boilers' (1889); 'Rope Driving' (1892); 'Dynamometers and the Measurement of Power' (1900).

Flat'tery, Cape. See CAPE FLATTERY.

Flat'ulence. See INDIGESTION.

Flatworms, worm-like animals of the phylum *Platyhelminthes*; especially those of the order *Turbellaria*, characterized by oval outline and decided flatness of body. See *Classification* in article ANATOMY; also PLANARIAN WORMS.

Flaubert, Gustave, güs-täv flō-bär, French novelist: b. Rouen, France, 12 Dec. 1821; d. Rouen 8 May 1880. His greatest novel was his first, 'Madame Bovary' (1857). He next wrote a historical novel, 'Salammbô,' the scene laid in the most flourishing period of Carthage — a splendid description of ancient Punic life, but having lively interest as a story; 'The History of a Young Man' (1869), like 'Madame Bovary,' a pessimistic picture of social life; 'The Temptation of St. Anthony' (1874), a piece of imaginative writing dealing with philosophical problems; and 'Three Stories' (1877), which had a favorable reception. The posthumous novel, 'Bouvard and Pécuchet' (1881) is a satire on humanity in general. His comedy, 'The Candidate' (1874), failed on the stage. See Tarver, 'Gustave Flaubert' (1895); Faquet, 'Flaubert' (1899).

Flav'el, John, English Nonconformist: b. Bromsgrove, Worcestershire, about 1630; d. Exeter 29 June 1691. He was graduated at Oxford University, inducted into the rectory of Dartmouth, Devonshire, in 1656, but dispossessed and ejected for nonconformity in 1662. During the remainder of an active ministry he preached from house to house and wrote devotional works, which were long popular, and among which are: 'Husbandry Spiritualized' (1669); 'Divine Conduct' (1678); 'The Touchstone of Sincerity' (1697); 'The Soul of Man' (1698); etc.

Flavian Caesars, flā'vi ạn sē'zạrz, the Roman emperor Vespasian and his sons and successors, Titus and Domitian, who were of the house of Flavius.

Flav'in, a yellow or orange dyestuff. American flavin is got from quercitron bark, and is said to be the same as quercitrin.

Flax (*Linum usitatissimum*). The use of flax has a greater antiquity than any other commercial fibre. It was cultivated and manufactured by the Swiss lake dwellers in the Stone Age in Europe, well preserved specimens of straw, fibre, yarn, and cloth being preserved in the museums. This ancient flax, however, was from another species, *Linum angustifolium*. The Egyptians produced and used flax thousands of years ago, and the Chaldæans and Babylonians carried its use to the highest state of textile development. Three thousand years ago the Phœnicians extended the culture, and the Greeks and Romans made it a household industry, and it became the aristocratic fibre. It is claimed that the ancient Mexicans knew of both flax and hemp, and its culture in this country goes back to the earliest date of our civilization.

A bast fibre, it may be considered, next to cotton, the most valuable and universally employed textile in the whole range of vegetable fibres. While the plant can be grown in nearly every portion of the temperate world, it is produced commercially in Great Britain and Ireland, Denmark, Sweden, Belgium, Holland, France, Germany, Russia, Austria, Spain and Portugal, portions of Africa and Asia, Japan and the Australian colonies. It thrives in Canada, the United States, and Mexico and in some of the South American countries. Good flax has been grown as far north as Alaska, and the flax of Archangel is famous.

Its cultivation was brought to this country by the American colonists, the records showing that considerable quantities were grown in eastern Massachusetts as early as 1630. Its growth was early extended to other States, though for the most part it was a household rather than commercial industry. In the fifties of the last century three quarters of a million pounds of flax were produced in the United States, Vermont, Connecticut, New York, and New Jersey leading in the culture. With the increased use of cotton fine flax culture steadily declined, and while, as late as 1869, 13,000 tons of flax were produced, a very small proportion was fine line, the bulk being mere tow for the bagging factories. A year or two later, when jute was admitted free of duty, the industry collapsed, At the present time we are growing flax to the extent of a million acres annually, but for the seed, for linseed-oil manufacture, and not for the fibre. The straw, which is rough and coarse, is largely thrown away, although in recent years attempts are being made to use the rough product for paper.

Good commercial fibre could be grown in many localities, notably in Michigan, Wisconsin, Minnesota, Oregon, and Washington. In a series of government experiments, conducted by the writer in the Puget Sound region of Washington, flax-straw was produced from which was hackled out a fibre valued by experts at $500 per ton. Very little line flax is produced at the present time, however, our commercial supply coming largely from Russia, Holland, Belgium, and Ireland; a little comes from Italy and Canada. Much of the «Irish flax» is grown in Belgium and sent to Ireland for preparation.

Nearly every country producing commercial flax has established grades and marks save the United States and Canada. In portions of Russia the grades bear the names of the districts where grown. The grades of Archangel flax are known by the terms first, second, or third Crown, etc., and first Zabrack, second Zabrack, while Riga flax is graded from the standard K as HK, PK, HPK, HSPK, etc. Holland flax is graded by roman numerals or by double numerals, as $\frac{\text{II}}{\text{IV}}$ $\frac{\text{I}}{\text{V}}$ VI, VII, etc., Belgian flax also by numerals except Friesland flax, which is lettered, as D, E, Ex, F, Fxx, and so on to Gxxx. French flax is known by the districts where produced and Irish flax by the counties where the flax is grown (see 'Descriptive Catalogue Useful Fibre Plants of the World,' p. 222). Our importations of all kinds of raw and hackled flax last year amounted to 8,466 tons, worth $2,227,141.

The culture of flax requires a deep, well-tilled soil, in high state of fertility, such as moist, deep, strong loams upon upland; a wet soil is disastrous and clays are therefore avoided; and a soil filled with the seeds of weeds is equally fatal to flax culture. The land must be deeply plowed and reduced to fine tilth by harrowing and rolling. In the preparation of the soil, especially in Europe, a systematic rotation of crops is practised, flax occupying the same land not oftener than once in 5 or 10 years. Imported Riga seed gives the best results, although Belgian Riga (Belgian seed produced from one sowing of Riga seed) gives a fine fibre. The common seed of the oil-mills should never be used for fibre culture. When flax is grown for the production of seed alone, to be sold to the oil-mills, the ground is seeded at the rate of two to three pecks to the acre. For fibre culture one and a half to three bushels is the proper quantity per acre.

After the seed has vegetated and is about two inches high the weeding begins, for no fine flax can be produced if the crop is choked with weeds. Flax is harvested by pulling the straw out of the ground roots and all, the straw being laid in handfuls to dry, and afterward made into bundles, which are stacked in the field. Practice varies, however, in different countries as to the handling before the retting period. In Flanders the greatest care is given to drying and storing, in order to keep the flax clean and bright for the final process of retting.

There are three methods of soaking or retting the straw: Dew retting is the simplest and the least careful. the straw being spread over the field like hay, to be retted by the dew, and by the action of the elements. Pool retting is practised by immersing the straw in pools of stagnant water, the softest water giving the best results. The pools are dug in the ground for the purpose, though a great deal of the Irish flax is retted in «bog holes.» Retting in running water is the third method, this form of retting being practised in Belgium; the famous Courtrai flax is retted in the sluggish and murky waters of the river Lys, the straw, in bundles, being placed in large crates and weighted with paving stones until the crates sink sufficiently to fully cover the flax. The flax of Courtrai, retted in the Lys, is the finest flax in the world. It is very light in color, clean, and even, and shows a superior tensile strength. The flax is given two immersions, the straw being taken from the crates and carefully dried before the second immersion.

The first operation in cleaning or extracting the fibre is to pass the straw through a breaker, which loosens the woody portions of the stem, and reduces them to fragments, to facilitate the next operation, the scutching, which whips out the «chive» and all waste matters and leaves the pure flax fibre. In former times the scutching was done by hand, though now machinery is generally used. The scutched flax is subsequently hackled or dressed by repeated combings, which removes the short and broken or tangled fibre, these combings producing tow. Each hackling adds to the quality of the fibre, and of course to the cost. Flax is usually imported in the scutched form, the hackled flax known as «dressed line.» The cheaper grades of flax come from Canada and Russia, the medium and finer grades from Holland, Belgium, and Ireland. The product is used in the United States for threads, twine, and crash, as no fine linen is woven in America. Mexico produces some good flax, and there are linen mills in Mexico city which produce fair grades of fabric. For the details of flax culture and manufacture, consult 'Special Reports' (Nos. 1, 4, and 10), office of Fibre Investigations of the Department of Agriculture; 'Spinning the Threads,' by A. R. Turner, Jr., in Jubilee number of 'New York Dry Goods Economist,' and 'Etudes sur La Culture le Rouissage et el Teillage du Lin,' by Alfred Renouard. See CORDAGE; CORDAGE INDUSTRIES; FIBRE; LINEN.

CHAS. RICHARDS DODGE,
Commercial Fibre Expert.

Flax'man, John, English sculptor and draughtsman: b. York, England, 6 July 1755; d. London 7 Dec. 1826. From his earliest years he exhibited and cultivated his talent for designing, and was also attracted by the picturesque conceptions of Greek mythology. He began to study at the Royal Academy in 1770, earning for some time a living by making designs for Wedgwood, the potter, and other persons. He went to Italy in 1787, and acquired the highest reputation by three series of designs, the illustrations to Homer, Æschylus, and Dante. He became a member of the Royal Academy 1797, and professor of sculpture there in 1810. The monument to Lord Mansfield in Westminster Abbey, the group of 'Cephalus and Aurora,' 'Psyche,' the group of the 'Archangel Michael and Satan,' are among his best works. He executed many exquisite bassi-relievi, compositions from Scripture subjects, and marked by some special religious sentiment. The monuments to Nelson, Howe, and Reynolds in St. Paul's are by his hand. One of his latest and finest productions is the 'Shield of Achilles.' The sculptures and sketches of Flaxman are now deposited and exhibited in a gallery called the «Flaxman Hall,» at University College, London. His 'Lectures on Sculpture' appeared in 1829, passed through a new edition in 1866.

Flaxseed, the seed of the flax plant (*linum*) largely used for domestic and medicinal purposes, produced in large quantities in the south of Europe, Egypt, parts of Asia and in the United States. (For a detailed description of the plant see FLAX; and for its commercial qualities other than seed, see FIBRE and LINEN.) The seeds of flax are dark brown, glossy, oval oblong, flattened, with acute edges, and pointed at one end. The seed is rich in an oil of such superior drying qualities as render it an indispensable ingredient in paint and varnish, and in the manufacture of linoleum, oilcloth, printer's ink, patent leather and other products and manufactures. The cultivation of the plant for fibre requires harvesting before the seed is fully ripe, which impairs the quality and reduces the quantity of the crop of flaxseed. The cultivation of flax for the seed requires a seeding of 2 or 3 pecks to the acre, and while it yields an increase of seed, the fibre straw is coarser; hence flax must be raised exclusively either for fibre or for seed. European countries cultivate flax for fibre, while the United States, Argentine and British India produce the world's commercial crop of flaxseed.

Introduction in America.— Flax for fibre was introduced in the United States soon after the landing at Plymouth. The seed for which there was obviously a limited domestic demand, gradually developed as an article of commerce. So long ago as 1791 the exports of flaxseed from the United States amounted to 292,460 bushels. In the same year began the manufacture of linseed oil in this country. In 1810 there were 283 linseed oil mills located in 14 States, 171 mills being in the State of Pennsylvania. The total annual output of these mills amounted to 770,583 gallons, representing 300,000 bushels of seed. In 1839 the first cargo of flaxseed ever brought into the United States was imported from Russia, and a few years later ships carrying ice to India brought flaxseed on the return voyages. From 1850 to 1870 India shipped a larger quantity of flaxseed to the United States than was produced in this country. From 1850 to 1860 half the entire crop here was grown in Ohio and Kentucky. The linseed oil mills divided or arranged themselves about 1891 into two groups, eastern and western. The former utilized the India imports of seed, while the western mills used the home product. In 1892 the United States took rank among the surplus flax-producing nations of the world and became an exporter of importance. In 1894 a short crop necessitated the import of 4,000,000 bushels. In 1903 there were 13 mills of large capacity in the Eastern States, 4 in Buffalo, 2 in New York, 3 in Philadelphia and other individual mills at Pittsburg and Allegheny, Pa., and Troy and Amsterdam, N. Y. These combined mills crush annually upward of 12,000,000 bushels of seed.

The Western Crop.— The flaxseed industry has migrated from its original western home in Ohio and Kentucky, State by State, until its present area includes North Dakota, South Dakota, Minnesota, Iowa and Wisconsin (known as the northwestern crop), and in Kansas, Missouri, Nebraska, Oklahoma and Indian Territory (known as the southwestern crop). Up to 1869, Ohio was the leading producing State. In 1879 Illinois produced the largest crop, 1,812,438 bushels. In 1889 North Dakota took the lead with a production of 7,776,610 bushels, and in 1902, out of a total production in the United States of 29,284,880 bushels North Dakota produced 55 per cent or 15,552,000 bushels. There are two varieties of seed produced in the West.

The small-grained seed of the Southwest yields an average of 17 pounds of oil to the bushel, while the larger-grained seed of the Northwest yields 20 pounds of oil to the bushel (56 pounds).

PRODUCTION OF FLAXSEED IN THE UNITED STATES.

DISTRICT	1849	1879	1909
	Bushels	Bushels	Bushels
Northwestern crop.....	315,506	6,010,700	24,953,000
Southwestern crop.....	13,696	970,956	783,000
All other States........	233,110	189,295	120,000
Total..............	562,312	7,170,951	25,856,000

FLAXSEED PRODUCTION OF THE WORLD.

COUNTRY	1899	1908
	Bushels	Bushels
United States..................	19,979,000	25,805,000
Russia.........................	18,022,000	18,630,000
Argentine......................	8,639,000	43,333,000
British India..................	17,116,000	6,528,000
Austria........................	735,500	932,000
France.........................	345,000	597,000
Other countries................	1,511,100	4,895,000
Total......................	66,347,600	100,729,000

The manufacture of linseed oil in the West has become largely localized in cities on and near the Great Lakes. There were 5 mills in Minneapolis recently, 6 in Chicago, 2 at Toledo, and 1 each at Cleveland, Milwaukee, South Bend, Ind., and Redwing, Minn. In the northwestern States of Iowa, North and South Dakota, there are but 3 mills, the bulk of all the western crop going to Chicago. Flaxseed in its natural state has no domestic uses on the farm, so that internal commerce involves the entire crop.

ACREAGE, PRODUCTION, AND VALUE OF FLAXSEED IN THE UNITED STATES IN 1909.

STATE	Acreage	Average yield per acre	Production	Average farm price Dec. 1	Farm value Dec. 1
	Acres	Bushels	Bushels	Dollars	Dollars
Wisconsin.....................	20,000	14.5	290,000	1.35	392,000
Minnesota.....................	450,000	10.0	4,500,000	1.50	6,750,000
Iowa..........................	30,000	9.8	294,000	1.30	382,000
Missouri......................	25,000	8.1	202,000	1.15	232,000
North Dakota..................	1,530,000	9.3	14,229,000	1.57	22,340,000
South Dakota..................	600,000	9.4	5,640,000	1.51	8,516,000
Nebraska......................	16,000	8.5	136,000	1.22	166,000
Kansas........................	55,000	7.0	385,000	1.10	424,000
Oklahoma......................	6,000	10.0	60,000	1.20	72,000
Montana.......................	10,000	12.0	120,000	1.60	192,000
United States.............	2,742,000	9.4	25,856,000	1.526	39,466,000

Flaxseed Products.—The principal product as understood is linseed oil. The residue after the extraction of the oil is the by-product the oilcake, a valuable cattle food, which, when ground, is known to commerce as linseed oil meal. Out of a crop like that for 1909 (39,000,000 bushels), there could be manufactured over 75,000,000 gallons of oil and upward of 1,000,000,000 pounds of oilcake. Of this vast quantity of oil the foreign demand only amounts to 100,000 gallons a year. Linseed oil has many uses and the monopoly of its field is so complete it has no substitutes nor adulterants. Probably 75 per cent of the oil manufactured is compounded with pigments and gums and used as paint and varnish. The remainder is utilized in making linoleum, oilcloth, printer's ink, waterproof fabrics not made of rubber, enamel for buttons, for making soap and for a few medicinal purposes. The oilcake, used only as a cattle food, finds an extensive market abroad. It is highly prized by European stockraisers, but little appreciated in America. About 80 per cent of the oilcake product is exported. Belgium alone bought 290,766,033 pounds in 1910. In the fiscal year 1909-10 oilcake to the value of $19,251,012 was shipped to foreign countries, and the average amount exported for 1908, 1909, and 1910 was 5,002,813,575 pounds. In the manufacture of linseed oil from flaxseed two processes are used, one known as the "old" or hydraulic press process, and the other as the "new" or naphtha process. The old process is in use generally throughout the United States, the new process being represented principally by one mill in Chicago. In December 1902 there were 40 linseed oil mills in operation in the United States. They contained 750 presses with a crushing capacity, if operated 250 days in the year, of 25,000,000 bushels, with an output of 70,000,000 gallons of oil.

AVERAGE PRICE OF FLAXSEED (PER BUSHEL).

MONTH	1891	1901	1908–9
January..........	1.19¼	1.66½	1.35 (1909)
April.............	1.20¼	1.61	1.40 (1909)
July..............	1.03¼	1.84½	1.18 (1908)
October...........	.95½	1.49½	1.30 (1908)

The value of the flaxseed crop as compared to the value of other crops raised in the United States in 1909, will be of interest:

Value of flaxseed crop......................	$25,856,000
Value of rye crop...........................	32,239,000
Value of buckwheat crop.....................	17,438,000
Value of barley crop........................	170,284,000
Value of tobacco crop.......................	95,719,365

Flea-beetles, small leaf-beetles of the tribe *Halticini*, of the family *Chrysomelidæ*, differing from other forms of this family by their extraordinary leaping power due to the enormously developed hind femora. Many of them are injurious to vegetation from their habit of eating the starting leaves full of holes, causing the drying up and death of the plant; hence certain species are known, as "tobacco flea," "potato flea," "cabbage flea," etc. In their larval state some species live on the root system of various weeds, the adults doing the principal damage to useful plants. Some species are also leaf-miners, while a few feed on the upper surface of leaves like the young of common leaf-beetles, but most species feed on both surfaces. One of the best remedies is bordeaux mixture, doubly efficient when mixed with Paris green and administered in the form of a spray. See LEAF-BEETLES.

Flea-hopper, either of two species of injurious minute black bugs of the family *Capsidæ*. The commonest is the garden flea-hopper (*Halticus uhleri*), which feeds and breeds normally on clover, but attacks all garden vegetables, commonly on the under sides of leaves, which it punctures so as to cause the death of the tissue in small irregular white patches. It somewhat resembles a flea-beetle (q.v.), but is remarkable in being dimorphic, a portion of the females having well-developed wings, the remainder being short-winged. The best remedy is kerosene emulsion as an under spray, and the avoidance of planting susceptible crops after the cutting of clover fields. A related species is known as the false flea-hopper (*Agalliastes associatus*).

Flea-louse, one of the jumping plant-lice of the family *Psyllidæ*, familiarly represented by a pest of the pear-tree (q.v.). Some of the species make galls.

Fleabane. See ERIGERON.

Fleas, minute wingless insects with bodies covered by a strong armor of fine scaly plates and mouth-parts formed for sucking. They constitute the order *Siphonaptera* and are related to the *Diptera*. Everyone is familiar with these troublesome parasites of man and domestic animals, but few persons have studied them sufficiently to know the larval and pupal stages, or to recognize the fact that there are many species. Only recently has it been established that the flea most annoying to human beings in America is not the human flea of the Old World (*Pulex irritans*), but the so-called dog-and-cat flea (*Pulex serraticeps*). Both species are of cosmopolitan distribution, but the former is fortunately extremely rare in this country, while the latter is to be found everywhere. Observations conducted by the United States Department of Agriculture have shown that the development of these insects is hastened by a moist or humid atmosphere. The egg stage is very short, th larvæ, which are worm-like, spin cocoons in which the pupal stage is formed in from 7 to 14 days after hatching and the imago appears five days later, showing that in the warmest weather an entire generation may develop in little more than a fortnight. Fleas will develop successfully in any situation where they are not too much disturbed, as in rugs, mats, or in straw or litter on which cats or dogs have slept; and they are also carried from one place to another by rats and mice and other animals. Dr. C. F. Baker ascertained in 1895 that there were 47 valid species of fleas in the United States; and probably this number might be doubled if all of the parasites of our larger animals were known. While many persons are indifferent to the presence of fleas others suffer severely from their attacks. Very many alleged cases of "hives" have been found to be produced by fleas, and epidemics of fleas in restricted areas as, for example, in several neighboring houses, have been traced to the body of an animal which had died near by The fleas desert the dying body of their host, jump on the clothing of any person passing, and are thus carried from house to house. One means of protection against them consists in avoiding carpets, and keeping the floors painted and covered with rugs, which should be frequently moved, swept and aired. Household pets should be kept out of the house during the summer time; in fact, it is better to exclude cats entirely, because they cannot be washed and freed from parasites so readily as dogs. Rats and mice also carry these and other parasites. The best remedy for those who suffer from fleas is to apply ammonia as strong as can be borne and as soon as possible to the bite, which in some persons is followed by an eruption as big as a dime, attended by severe itching The free use of baking soda would serve nearly the same purpose where ammonia cannot readily be obtained. Consult: Howard & Marlatt 'Household Insects of the United States,' issued by the Department of Agriculture.

Fleece Golden, in Grecian mythology, the fleece of gold taken from the ram on which Phrixus and Helle escaped from being sacrificed.

Fleece, Order of the Golden, a military order instituted by Philip the Good, Duke of Burgundy, at Bruges, 10 Jan. 1429, on the occasion of his marriage with the Portuguese princess, Isabella. The order now belongs to both Austria and Spain. See GOLDEN FLEECE, ORDER OF.

Fleet, (1) A tidal stream, so called from the swiftness of its current, which flowed by the walls of old London city; the title is also applied to a creek; an inlet or arm of the sea, as North-fleet, etc. (2) Fleet Street, London, derives its name from the Fleet ditch. (3) The Fleet, or Fleet Prison, an historic prison in London, so called from its being situated by the side of the Fleet ditch. In it were confined persons committed by the ecclesiastical courts and the courts of equity, exchequer, and common pleas. It existed from the 12th century until its abolition in 1846. (4) Fleet books, the original records of the marriages celebrated in the Fleet prison, between 1686 and 1754. (5) Fleet marriages, marriages performed clandestinely and without banns or license by the poor chaplains in the Fleet prison, previous to 1754, when they were declared illegal by the Marriage Act.

Fleet'wood, Charles, English soldier: b. Northamptonshire, England; d. Stoke Newington, London, 4 Oct. 1692. He was of good family, studied law, was elected member of Parliament in 1646, and appointed governor of the Isle of Wight in 1649. He was made lieutenant-general of cavalry in Cromwell's army, distinguished himself at the battle of Worcester (1651) and married Bridget, Henry Ireton's widow, the daughter of Cromwell. He was put in command of the troops in Ireland, where he resided as Lord Deputy until 1655. He was appointed general of Richard Cromwell's army 18 Oct. 1659, but on the promotion of Monk in December 1659, he resigned. After the Restoration he retired to obscurity at Stoke Newington.

Fleetwood, George, English parliamentarian: b. in Buckinghamshire, England; d. in America about 1665. He represented his native shire in the Long Parliament (1647). He signed the death warrant of the king, raised a regiment of horse for Cromwell's army and was by the latter raised to the peerage. By the government of Charles II. he was condemned to death as a regicide, but on changing his allegiance, the sentence was mitigated to confiscation of his estates, and he emigrated to America.

Fleetwood, or Brandy Station, Battle of. Gen. Hooker, suspecting that Gen. Lee was gathering his forces on the upper Rappahannock for a movement northward, and informed that Gen. Stuart's Confederate cavalry was at Culpeper Court House, ordered Gen. Pleasonton, who was at Catlett's Station, to cross the Rappahannock at Beverly and Kelly's Fords, attack Stuart, and ascertain Lee's intentions. Pleasonton had the cavalry divisions of Buford and Gregg, and Hooker sent him two picked provisional infantry brigades of 3,000 men, under Gens. Ames and Russell, making in all, cavalry and infantry, an effective force of 10,900 men. Stuart had five brigades of 10,200 men. At daybreak 9 June 1863 Buford, with his cavalry and one brigade of infantry, crossed at Beverly Ford and encountered one of Stuart's brigades, under command of Gen. Sam Jones, and a severe contest ensued, in which the 8th New York cavalry, Col. B. F. Davis, was routed and its commander killed. A charge of the 8th Illinois cavalry drove Jones back two miles, where he joined Stuart and the two brigades of Wade Hampton and W. H. F. Lee. Meantime Gregg, with his cavalry division and an infantry brigade, crossed the river at Kelly's Ford, and pushing back Robertson's brigade, approached Fleetwood Hill from the east, as Buford moved on Brandy Station from the northwest. Fleetwood Hill is a few hundred yards north of Brandy Station, and a hard hand-to-hand struggle ensued at both points, with varying success. Buford held his own near Brandy Station, but Gregg, at Fleetwood Hill, was finally compelled to withdraw, leaving three of his guns in the hands of the enemy. Pleasonton, satisfied that a great part of Lee's army was in his front, recrossed the Rappahannock with about 100 prisoners. The Union loss was 484 killed and wounded and 382 missing. The Confederate loss was 485, of whom 301 were killed or wounded. This engagement marks the beginning of the Gettysburg campaign. Consult: 'Official Records,' Vol. XXVII.; The Century Company's 'Battles and Leaders of the Civil War,' Vol. III.

E. A. Carman.

Fleischer, Heinrich Leberecht, hīn'riH lā'be-reHt flī'sher, German Orientalist: b. Schandau, Saxony, 21 Feb. 1801; d. Leipsic 10 Feb. 1888. He was professor of Oriental languages at the University of Leipsic 1836–88. Beside editing Ali's 'Hundred Sayings' (1837), and other works, he wrote a 'Critical Dissertation on Habicht's Glossary to the First Four Volumes of the Thousand and One Nights' (1836); 'Grammar of the Modern Persian Languages' (1875); 'Kleinere Schriften' (1885–8).

Fleming, George. See Fletcher, Julia Constance.

Flem'ing, John Ambrose, English electrical engineer: b. Lancaster, England, 1849. He was educated at the Royal College of Chemistry and St. John's College, Cambridge, and has been associated for many years with the progress of electrical science. He has published: 'Short Lectures to Electrical Artisans' (1885); 'Treatise on the Alternate Current Transformer' (1889–92); 'Electric Lamps and Electric Lighting' (1894); 'Magnets and Electric Currents' (1897); 'Waves and Ripples in Water, Air, and Ether' (1902); etc.

Fleming, May Agnes Early (Mrs.), Canadian story-writer: b. New Brunswick 1840; d. 1880. She was a prolific author of romances, mostly sensational, among them being: 'Guy Earlscourt's Wife'; 'Lost for a Woman'; 'Pride and Passion.'

Fleming, or Flemming, Paul, powl, German lyric poet: b. Hartenstein, Saxony, 5 Oct. 1609; d. Hamburg 2 April 1640. As an attaché of an embassy to Russia and Persia, he had an opportunity (1635–9) of studying many peoples. His 'German Poems,' which appeared in 1642, has been often republished.

Fleming, Richard, English prelate: b. Yorkshire about 1360; d. 1431. At first a supporter of Wiclif's doctrines he subsequently, when bishop of Lincoln, became staunchly orthodox and is remembered as the prelate who dug up and burned the body of Wiclif and cast the ashes into the Swift. He planned a college at Oxford to be a bulwark against heresy, but the present Lincoln College was, however, not founded till after the bishop's death.

Fleming, Sir Sandford, Canadian engineer: b. Kirkcaldy, Fifeshire, Scotland, 7 Jan. 1827. He went to Canada in 1845 where he constructed the Inter-Colonial Railway through Nova Scotia, New Brunswick and Quebec. He was engineer in chief of the Canadian Pacific Railway 1871–80, and has published: 'The Inter-Colonial: a History, 1832–76'; 'England and Canada'; 'Time and its Notation'; etc. He was knighted in 1897.

Fleming, William Hansell, American Shakespearian scholar: b. Philadelphia, Pa., 23 Aug. 1844. He was educated at Princeton University and has published: 'How to Study Shakespeare' (1897–9), and edited the 'Bankside Shakespeare.'

Flem'ingsburg, Ky., a town and county-seat in Fleming County, on the Covington, F. & A. R.R. Pop. 1,800.

Flem'ington, a town and county-seat of Hunterdon County, N. J., on the Pennsylvania, the Lehigh Valley, and the Central Railroad of New Jersey, 50 miles west of New York. Pop. (1910) 2,693.

Flemish Art. See Flemish School.

Flemish Bond, in bricklaying, a particular mode of disposing bricks in a wall, so as to tie and break joints. It consists of a header and stretcher alternately.

Flemish Brick, European brick used for paving; 72 will pave a square yard. They are of a yellowish color, and harder than the ordinary bricks.

Flemish Language and Literature. *Vlāmisch* or *Duytsch,* the Low German vernacular spoken by the Vlamingen or Flemings inhabiting the Belgian provinces of East and West Flanders, parts of Holland and the French department of Nord, is akin to the Frisian and to the Hollandish or Dutch which is its younger branch. The latter differs from Flemish in having been reformed and simplified, while Flemish retains the greater part of the archaic features of its 16th century spelling, pronunciation, and words and forms of speech of French and Spanish origin. Since Belgium became an independent kingdom in 1830, a strong desire has been manifested to foster Flemish traditions and to cultivate and promote its language and literature; before that date its history is identified with that of Dutch language and literature. (See HOLLAND.) Among early Flemish literature is the 'Spiegel historical' (historic mirror) of Jacob van Maerlant (1235–1300), a translation of 'Boece' or 'Boethius' by Jacob Velt of Bruges in the 15th century, and the 'Hive of the Catholic Church,' by Philip van Marnix (1569). The modern movement to rehabilitate the vernacular was largely due to the efforts of Jan Frans Willem who before the separation of Belgium from Holland had strenuously advocated its use as a literary language. With the able co-operation of such authors as Van Ryswyck, Ledeganck, Rense, Van Duyse, Blieck, Serrure, David Conscience and others, the movement made great progress, received official support, and was crowned with success in 1886 when the Koninklije Vlaamsche Akademie (Royal Flemish Academy) was founded and the use of Flemish, as well as French, was adopted as the legal and official language of the kingdom. Prominent amid modern Flemish literature is the verse of Ledeganck: 'De drie Zustersteden,' 'De Hut in 't Wowd,' etc.; of Ryswyck, 'Antigonus,' 'Eppenstein,' and 'Oorspronkelikje Verhalen'; of Van Beers, 'Begga,' 'Levensbeelden' and 'Gevoel en Leven.' Among works of fiction are Hendrick Conscience's 'Artevelde'; Delcroix's 'Geld of Liefde' and 'Philippine van Vlaanderen'; Sleeckx's 'In 't Schipperskwatier' and 'Dirk Meyer'; and Sneiders' 'De gasthuisnon.' Other well-known novelists are Bergmann, Madame Courtmans, and the two poetesses, Rosalie and Virginie Loveling, poets also including Dantzenberg, De Cort, and Van Droogerbroeck. Representative drama is Sleeckx's 'Meester en Knecht,' and 'Zannekin.' Consult: Willems, 'Sur la langue et la littérature neerlandaises, par rapport aux provinces méridionales des Pays-Bas' (1818); Vercoullie, 'Spraakleer van het Westvlaamsch' (1894); Hamelius, 'Histoire politique et littéraire du mouvement flamand' (1894).

Flemish School, a school of painting which originated in Flanders in the early part of the 15th century, with the invention, or at least the first practice, of painting in oil. It has been generally attributed to Jan Van Eyck, who was accustomed to varnish his distemper pictures with a composition of oils. In course of practice he came to mix his colors with oil instead of water, which rendered them brilliant without the trouble of varnishing. From this and subsequent experiments arose the art of painting in oil. The chief early masters of the school were Jan Van Eyck and his brother and sister, Hubert and Margarete, Matsys, Mabuse, Memling, Weyden, and Moro; to the second period belong Rubens, VanDyck, Snyders, Jordaens and the younger Teniers.

Flensburg, flens'boorg, Prussia, a town in the province of Schleswig-Holstein, 20 miles from the town of Schleswig. It was a place of importance as early as the 12th century, but subsequently suffered much from wars and conflagrations. It is again prosperous, and is now the most important town in Schleswig. The industrial establishments include ship-building yards, sugar-refineries, tobacco-factories, soap-works, foundries, breweries, distilleries, etc. In 1866 it fell to Prussia, along with the duchy of Schleswig-Holstein.

Flesh (or muscle) is composed of the proteids, myosin, musclin, myoglobulin, and myo-albumin, together with varying amounts of fats, salts, and nitrogenous extractive substances. Of the three classes of foodstuffs needed in the human economy, meat supplies most of the proteid and fat, while the vegetable kingdom supplies the carbohydrates. The proteids are more properly the tissue-building elements, while the fats and carbohydrates are more readily oxidizable, and supply the body with energy. Proteids must be taken as such, since the human economy cannot cause conversion of the other sorts of food into proteids. The minimum of these various substances for the proper preservation of life has not been positively determined, but approximately the average healthy man requires 100 grams of fat, 400 grams of carbohydrate, and 100 grams of proteid per diem. The necessary amount of proteid material can be obtained from the vegetable kingdom, and there is no doubt that some systems are better suited for this diet; but to the large majority of individuals a mixed diet, containing a certain amount of meat, is more readily taken care of. The meat proteids are usually more quickly and completely digested.

The nitrogenous extractive substances, ceratine, the xanthin bases, and the like, are also of value to the system because of their power of exciting gastric secretions and stimulating circulation. The various meat extracts contain a large proportion of these substances, and most of them have little else. An overabundance of meat very frequently causes a nervous, irritable condition. This is less true of the so-called white meats, a difference not to be explained on the ground that the white meats contain less of the extractives, since the opposite is the case. As a general rule the diet of the well-to-do in America is entirely too high in food-value, but particularly in the amount of albuminous foods. These constant errors find their expression in the well-nigh universal complaint of dyspepsia and so-called uric-acid disturbances. Such intoxications are almost sure to follow if more animal food is taken than can be digested and absorbed. Putrefaction of the unabsorbed food takes place, with generation of toxic substances and absorption of them into the general circulation.

Flesh-fly, any of a large group of showy flies (family *Sarcophagidæ*), the more familiar and typical members of which breed in decaying flesh. Some, however, pass their larval stages in dung, or decaying vegetables, or are parasitic in the wounds and sores of animals and man. Most of them look like large house-flies, sometimes bright with metallic blue or green, or gray with black stripes; common names are "blue-bottle" (for *Lucilia cæsar*, which often comes into houses in stormy weather), or "green-bottle," for the "blow-flies" (q.v.) of the genus *Calliphora*. The common flesh-fly of Europe (*Sarcophaga carnaria*) is a pest that does not appear in the United States, but we have a very similar and equally troublesome species in *S. sarraceniæ*. The directness with which these flies find and utilize a piece of decayed meat, for the deposit of their eggs, or their living maggots, avoiding fresh meat equally accessible, is regarded as an evidence that they are under the control of an impulse of a chemical character rather than merely following a sense of smell.

Fleshly School, The. See Decadents.

Fletch'er, Alice Cunningham, American ethnologist: b. Boston, Mass., 1845. She is the originator of the scheme by which loans are made to Indians in order that they may buy lands and build houses. She is now employed in the management of the Peabody Museum of American Archæology and Ethnology, and is the author of 'Indian Story and Song from North America' (1900).

Fletcher, Andrew, of Saltoun, Scottish political writer and patriot: b. Saltoun, Haddingtonshire, 1655; d. London, September 1716. Having distinguished himself in opposition to the court he deemed it prudent to retire to Holland; and on his non-appearance to a summons from the lords in council he was outlawed. In 1685 he joined the enterprise of the Duke of Monmouth. He subsequently joined the Scottish refugees in Holland, and when the revolution of 1688 took place returned to England with William of Orange, resumed possession of his estate, and became a member of the convention for settling the new government in Scotland. In 1698 he printed 'A Discourse on Government in Relation to Militias'; and also, 'Two Discourses Concerning the Affairs of Scotland.' His tracts and some of his speeches appeared in one volume, entitled: 'The Political Works of Andrew Fletcher, Esq.' (1737). Consult Omond, 'Fletcher of Saltoun' (1897).

Fletcher, Benjamin, English colonial governor. He was appointed by William and Mary in 1692, after serving during the war in the Low Countries, as well as in Ireland. When William Penn was for a time deprived of his proprietary rights he acted as governor in Pennsylvania (1693-4). He was at last forced to resign from his post in New York, and many charges were made against him. Consult: Wilson, 'Memorial History of the City of New York' (1892).

Fletcher, Giles, English poet: b. Watford, Hertfordshire, about 1549; d. London March 1611. He was ambassador to Russia in 1588, but his description of that country, 'Of the Russe Common Wealth,' appearing in 1591, was suppressed. It was reprinted for the Hakluyt Society 1856. He also wrote: 'Licia: Poems of Love' (1593).

Fletcher, Giles, English poet: b. about 1588; d. 1623. He was a son of Giles Fletcher the elder, and wrote the poem, 'Christ's Victory' (1610). A new edition appeared in 1824.

Fletcher, James Cooley, American clergyman and author: b. Indianapolis, Ind., 1823. Between 1851 and 1865 he traveled widely as a missionary in Brazil, and was at one time secretary to the United States legation at Rio de Janeiro. In 1869-73 he was consul at Oporto, Portugal, later was a missionary in Naples, Italy, and from 1877 was resident at Indianapolis. His 'Brazil and the Brazilians,' early editions of which contain the name of D. P. Kidder as associate author, was long the authoritative English work on the subject.

Fletcher, John. See Beaumont, Francis, and Fletcher, John.

Fletcher, Joseph Smith, English journalist and novelist: b. Halifax, Yorkshire, 1863. He has written extensively for newspapers under the pseudonym "A Son of the Soil," as well as novels and collections of short stories which have been very popular, and several of which have been widely read in the United States. His published books include: 'Anima Christi' (1884); 'When Charles the First was King' (1892); 'Poems' (1892); 'The Quarry Farm' (1893); 'The Wonderful Wapentake' (1894); 'Where Highways Cross' (1895); 'Mistress Spitfire' (1896); 'Ballads of Revolt' (1896); 'Life in Arcadia' (1896); 'At the Gate of the Fold' (1896); 'God's Failures' (1897); 'The Making of Matthias' (1897); 'The Builders' (1897); 'The Paths of the Prudent' (1899); 'From the Broad Acres' (1899); 'Morrison's Machine' (1900); 'The Harvesters' (1900); 'A Picturesque History of Yorkshire' (1899-1900); 'The Three Days' Terror'; 'The Golden Spur' (1901); 'Bonds of Steel'; 'The Investigators' (1902); 'In the Days of Drake'; 'At the Blue Bell Inn.'

Fletcher, Julia Constance (pseudonym "George Fleming"), American novelist; b. Rio Janeiro, Brazil, 1858. She is a daughter of James Cooley Fletcher (q.v.). She has resided for years in Italy and in London. Her novels are: 'Kismet' (1877); 'Mirage' (1878); 'The Head of the Medusa' (1880); 'Andromeda' (1885); 'The Truth about Clement Ker' (1889); 'For Plain Women Only' (1895); and 'Little Stories about Women' (1897). She has also written the plays: 'Mrs. Lessingham' (1894); 'A Man and His Wife' (1897); 'The Canary' (1899); 'The Fantasticks' (1900).

Fletcher, Lazarus, English mineralogist: b. Salford, England, 3 March 1854. He was educated at Balliol College, Oxford, and has been keeper of minerals in the British Museum from 1880. He has published: 'Introduction to the Study of Meteorites' (1881); 'Introduction to the Study of Minerals' (1884); 'The Optical Indicatrix' (1892); 'Introduction to the Study of Rocks' (1895).

Fletcher, Phineas, English poet: b. Cranbrook, Kent, April 1582; d. about 1650. He was a son of Giles Fletcher the elder and a cousin of John Fletcher (q.v.). He was the author of 'Sicilides,' a pastoral drama (1614); 'The Purple Island and Piscatory Eclogues' (1633). 'The Purple Island' is an allegorical description of man, founded upon an allegory in the ninth canto of the second book of the 'Faerie Queene.' It is composed in the Spenserian manner, and is not without passages of strong fancy and beauty of description. In the first five cantos, however, the reader loses the poet in the anatomist — a character but little adapted to the handling of poetry. When, however, he steps from the physical to the intellectual man, he not only attracts, but secures attention by a profusion of images, many of which are distinguished by much boldness of conception and brillancy of coloring. The 'Piscatory Eclogues' have considerable sweetness of versification, and much descriptive elegance. Milton was indebted to both Phineas and his brother Giles for different passages of the 'Paradise Lost' and 'Paradise Regained.'

Fletcher, Robert, American surgeon: b. Briston, England, 1823. He was graduated at the Royal College of Surgeons 1841; came to the United States, and was surgeon of an Ohio regiment during the Civil War. He afterward became principal assistant librarian of the surgeon-general's office at Washington, D. C., and professor of medical jurisprudence in the Columbian University. He has published: 'Paul Broca and the French School of Anthropology' (1882); 'Human Proportion in Art and Anthropometry' (1883); 'The New School of Criminal Anthropology' (1891); 'Scopelism' (1897)

Fletcher, Robert Howe, American soldier and author: b. Cincinnati, Ohio, 21 July 1850. He entered the United States Naval Academy at 17, and at graduation was transferred to the army where he served on the Indian frontier and in California till 1886. Since 1898 he has been curator of the Mark Hopkins Institute of Art at San Francisco. He has published: 'A Blind Bargain'; 'The Johnstown Stage'; 'Marjorie and Her Papa.'

Fletcher, William Isaac, American librarian: b. Burlington, Vt., 28 April 1844. He has been librarian of Amherst College from 1883 and is the author of 'Public Libraries in America' (1895); and was joint editor of 'Poole's Index to Periodical Literature.' He has also edited continuations of the latter (1882–1900); the 'A. L. A. Index to General Literature' (1893); and the 'Co-operative Index to Periodicals' (1883–91)

Fletcherism. This is a new term invented to apply to a new science — or art, viz., that of mastication, as taught by Mr. Horace Fletcher. The verb to Fletcherize, is also derived from the same source, and for the same reason. The words now have wide usage; and are probably in the English language to stay. Mr. Fletcher found that the average human being did not masticate his food as thoroughly as he should; and set about ascertaining what would happen if every mouthful were masticated until it had been completely dissolved and reduced to a creamy pulp. It was soon found that some foods required several hundred motions of the jaw to be sufficiently reduced; others lost their taste and became noxious when submitted to this prolonged mouth-treatment; in other cases, solid portions of the food — husks, etc.,— came to the front of the mouth of their own accord; and could be swallowed only with difficulty. If mastication be followed to the point required, it will be found — says Mr. Fletcher — that no voluntary movements of swallowing are required; it «swallows itself,» as it were by physiological action.

Certain physiological effects follow this practice. In the first place, Mr. Fletcher found that far less food was necessary than was customarily the case; the body is satisfied with less, for the reason that it is capable of assimilating more of what is eaten. Work is taken off the stomach and bowels. But little work is thrown on any of these organs; the energy of digestion is saved; toxins are not formed in the body, and fatigue is largely prevented. One following this method of living, says Mr. Fletcher, is «always in training, for the reason that he has not put into his body an excess of food-material for the elimination of which a long course of training is necessary.» Further, one is rendered immune from many diseases, because of the high standard of health maintained by the body. Less sleep is required on such a diet, for the reason that less energy is used, and less poison is formed during the day, by the bodily activities. «Fletcherism» simply means the thorough mastication of all food until it is in a liquid condition. Mr. Fletcher has stated his views and arguments in full in his two books, 'The New Gluton or Epicure'; and 'The A. B.-Z. of Our Nutrition.'

Dr. Elmer Lee and other physicians are inclined to doubt the validity of Mr. Fletcher's views,— saying that too much chewing is not physiological, and that the benefits to the system are open to question. However, the experiments of Chittenden, of Yale, have shown us that health and efficiency can be maintained and even increased by this system of dieting; and demonstrated this on three sets of men — college professors, athletes, and a squad from the army,— who consented to try the reduced diet for several months. In all cases the results were the same. Professor Chittenden also tried the effects of a low proteid diet on dogs; showing that the lessened proteid intake would answer in their cases also. (Consult his 'Physiological Economy in Nutrition;' and 'The 'Nutrition of Man.')

One of the principal benefits said to be derived from this system is that a far lower intake of proteid is necessary than when food is eaten in the ordinary manner. Chittenden proved that only one-third the amount of proteid is necessary than is usually said to be requisite by authorities on nutrition. This Chittenden's experiments seem to have proved. Other advantages which this system is said to offer are: improved conditions of the nose and throat (by reason of the greater exercise which these muscles receive); improved teeth; decreased intestinal auto-intoxication, etc.

This dietic system or doctrine has attained great prominence during the past few years, owing largely to the fact that Mr. Horace Fletcher's theories were made the subject of investigation and test by such eminent physiologists as Professor Chittenden, of Yale; Huggins, of Cambridge, etc. The history of the rapid rise and spread of this doctrine should prove of some interest.

Several years ago, Mr. Fletcher found himself ill, as a result of wrong living, and, although he tried all the remedies then in vogue he failed to find benefit from any of them. At this time, he heard of the «fasting cure» and of the benefits to be derived from a lessened intake of food, and he determined to try it. His early experiments helped him somewhat; and he determined at this time to see what effect upon his body a very thorough mastication of all food would have. He was astonished with the results. The various bodily ills from which he had been suffering — both major and minor — completely vanished; and health returned with a vim that amazed him. Believing that he had made a valuable physiological discovery, he induced several of his friends to try this method of living, and in every case good results were reported. Dr. Van Somern, and Sir Michæl Foster were among the first to recognize in this system of alimentation a cure for many diseases, and wrote in defence of the question from the physiologist's point of view. Soon after this, Professor Chittenden became interested, and instituted a long series of experiments, which have since become famous. He induced three groups of men to undergo a prolonged test, when placed upon this system of diet — college athletes, college professors, and a squad of the army,— known afterwards as the «starvation squad.» The results of these experiments were published in Chittenden's book, 'Physiological Economy in Nutrition.'

In all these experiments the results were the same. The subjects of the experiments increased in speed, skill, strength, and endurance, and their reaction times and mental work was found in every case to be improved, and of higher quality. Not only did the soldiers go through the regular work in the gymnasium required of them in the army, but a great deal of extra work also; so that they went through what was certainly a fair test of endurance. It was continued for several months. The nitrogen equilibrium was found to be maintained on about one-third as much proteid as is usually said to be necessary by physiologists; and they ate only about one-third as much in their daily food. Its only difference consisted in the fact that every particle of food eaten was masticated very thoroughly before being swallowed — it was «Fletcherized.»

Fletcherism consists simply in this: that every particle of food is masticated so completely and so thoroughly that it is reduced to a liquid mass before it is swallowed. This throws less work on the stomach and intestines, by reason of the fact that the food is more completely broken-up before being swallowed. Further, certain chemical changes take place in the mouth, which do not take place, when mastication is less perfect. The body is thus nourished more fully on a less amount of food, and in consequence of this lessened intake of food, the body is cleansed, and rids itself from a host of ills to which it has been heir. The principle of the doctrine is simplicity itself; and it has been found to «work» in the majority of cases tried. It may be true, as Dr. Elmer Lee, and other physicians, have asserted, that Fletcherism is injurious when carried to an excess; but, in the majority of cases, it seems to be good and helpful in its effects.

Fleur-de-lis, fler-de-lē, an heraldic emblem probably derived from the iris-plant. Some of the great families of France (most of whom are now extinct) bore the emblem on their shields from the very commencement of the practice of blazoning, and a large number of families in Germany, Sweden, Switzerland, and other parts of Europe have borne the fleurs-de-lis on their coats of arms from the 12th century. The great popularity of this emblem in France dates from the 13th century. The royal coat of arms of France consisted of three golden lilies on a blue ground, with the device, '*Lilia neque nent neque laborant.*' The shield of France was anciently, in heraldic language, *semé de fleurs-de-lis*, that is, bore this emblem scattered over the shield. It is commonly believed that it was Charles V. (1364–80) who reduced the number to three; but this is disproved by the fact that two seals have been preserved, the one belonging to Philip the Fair (1285–1314), the other belonging to Philip of Valois (1328–50), both of which bear three fleurs-de-lis; and the town library of Rouen contains a collection of charts relating to the celebrated abbey of Savigny, to one of which, bearing the date 1212, a seal is attached, which is still in a state of perfect preservation, representing three fleurs-de-lis exactly similar to those used on the shield of France. Hence it appears that the use of this emblem in a triple form is much more ancient than is usually thought. See HERALDRY.

Fleurus, fle-rūs, a town in Belgium, province of Hainaut, seven miles northeast of Charleroi. It has manufactures of coarse woolens and flax, with some tanneries and salt-works, and a trade in agricultural produce. In the vicinity, in August 1622, the Spaniards under Gonzales defeated the army commanded by Ernst von Mansfield; 1 July 1690, the French under Marshal Luxenbourg defeated the Germans under Prince Waldeck; and 26 June 1794, the French republican forces under Marshal Jourdan defeated the Austrian army. The battle of Ligny, also, is sometimes known as the battle of Fleurus, Ligny being only about two miles from Fleurus.

Fleury, Andre, Hercule de, än-drā ar-cül de fle-rē, a cardinal and prime minister of France under Louis XV.: b. Lodève, Languedoc, France, in 1653; d. 29 Jan. 1743. Coming to court, he won general favor by his pleasing person and fine understanding; became bishop of Fréjus; and, through the interest of Madame Maintenon, was appointed instructor to Louis XV. In 1726 he was made cardinal, placed at the head of the ministry, and from his 73d to his 90th year he administered the affairs of his country with great success.

Fleury, Claude, clōd, French Church historian: b. Paris, France, 6 Dec. 1640; d. there 14 July 1723. His learning and unaffected simplicity made him a notable figure at the court of Louis XIV., and later at that of Louis XV., whose confessor he became. An 'Ecclesiastical History' (1691–1720) forms his claim to enduring renown; the work coming down to 1414, at which point a later writer has attempted, though not sympathetically, to round out the master's performance. 'A History of French Law' (1674) and a 'Historical Catechism' (1679) are less important achievements.

Fleury-Husson, Jules. See CHAMPFLEURY.

Flexibility, in physics, the property which all bodies possess to a greater or less degree, and which is evinced in their disposition to yield or change their form in a direction at right angles to their length, through their own weight or by means of any pressure or strain applied to them. Pieces of the same material differ from each other in the degree of flexibility they exhibit in proportion to their length and thickness. See PHYSICS.

Flexner, Simon, American pathologist: b. Louisville, Ky., 25 March 1863. He was graduated from its University of Louisville as M. D. in 1889. He then became a post-graduate student at Johns Hopkins University and subsequently pursued his pathological studies at the University of Strasburg. He was professor of pathology, Johns Hopkins University 1891–8; and of pathological anatomy 1898–9, and has been professor of pathology in the University of Pennsylvania since the year last named. He was also director of Ayer Chemical Laboratory, Pennsylvania Hospital, 1901–3; and pathologist of University Hospital and Philadelphia Hospital 1899–1903. His ability was further recognized by his being chosen in 1902 director of the Rockefeller Laboratory of Research in New York, established to promote the study of the origin of disease. Among his publications are: ‘The Pathology of Tox-Albumin Intoxication’; ‘Micro-organisms’; ‘The Bacillus Pyogenes Filiformis’; ‘The Aetiology of Dysentery’; ‘Terminal Infections’; ‘Experimental Pancreatitis’; ‘The Nature of Snake Venoms,’ and many other papers and monographs relating to bacteriological and pathological subjects.

Flexure, in mechanics, is a species of strain in which a solid body is distorted so that certain of its original planes become converted into cylindrical or conical surfaces. The term is most commonly used in connection with beams, where it signifies the elastic yield of the beam under the influence of its load. When a beam is supported at both ends and loaded in the middle, it sags in such a manner that its originally straight longitudinal fibres become curved into approximately circular arcs. The radius of these arcs is very large, of course, in practical construction, where the beams are composed of steel or wood. In a beam that is supported and loaded as described above, the upper fibres of the beam are in compression, and the lower ones in tension. The compressive strains in the upper parts, and the tensile strains in the lower parts, decrease toward the middle of the beam, and somewhere about the middle there is a surface (called the «neutral surface,» or «neutral axis»), on which there is neither tension nor compression. The flexure of such a beam is measured by the depression of its centre under the influence of the load; this depression being directly proportional to the product of the load by the cube of the length of the beam between supports, and inversely proportional to the continued product of the horizontal thickness of the beam, multiplied by the cube of its vertical depth, and again by the value of Young's modulus for the material of which the beam is made. (See ELASTICITY; STRENGTH OF MATERIALS.) Consult also, Rankine, ‘Useful Rules and Tables.’

Flick, Lawrence F., American pathologist: b. Carroll Township, Cambria County, Pa., 10 Aug. 1856. He was educated at the Benedictine College near Latrobe, Pa., and was graduated in medicine at Jefferson Medical College, Philadelphia, in 1879. He took up tuberculosis as a specialty and early in his career began a movement for the prevention of this disease. In June 1888, he read a paper upon the contagiousness of phthisis before the Medical Society of the State of Pennsylvania, showing that houses which had been occupied by consumptives gave the disease to subsequent occupants, and that the malady was essentially a contact disease. He subsequently published many monographs upon this topic, and 1890 started a movement for the establishment of consumption hospitals which culminated in the founding of the Rush Hospital for diseases of the chest. In 1892 he founded the Pennsylvania Society for the Prevention of Tuberculosis, of which he was president for some years. In 1895 he helped to found the Free Hospital for Poor Consumptives and was elected its president. In 1903 he was entrusted with the establishment of the Henry Phipps Institute for the Study, Treatment and Prevention of Tuberculosis and was appointed its medical director.

Flick'el, Paul, powl, German artist: b. Berlin 8 April 1852. He studied three years in the Art School at Weimar, and in 1874 went to Düsseldorf and in a year began his career as a landscape painter. He traveled for the sake of studying art in Germany and Austria. In 1877 he continued his wandering in Italy and on the spot painted many pictures, such as ‘The View of Naples from Capo di Monte’; ‘Garden at Monte Carlo’; ‘Fountain of the Villa Borghese,’ scenes in which he showed a skilful management of bright sunlight effect, and complete mastery in handling the luxuriant vegetation of the south. His pictures of mountain forest scenery in Austria attracted notice and his ‘Beech Forest,’ which was based on studies made near Prerau, Moravia, gained for him the «Great Gold Medal» at the Berlin exhibition of 1886.

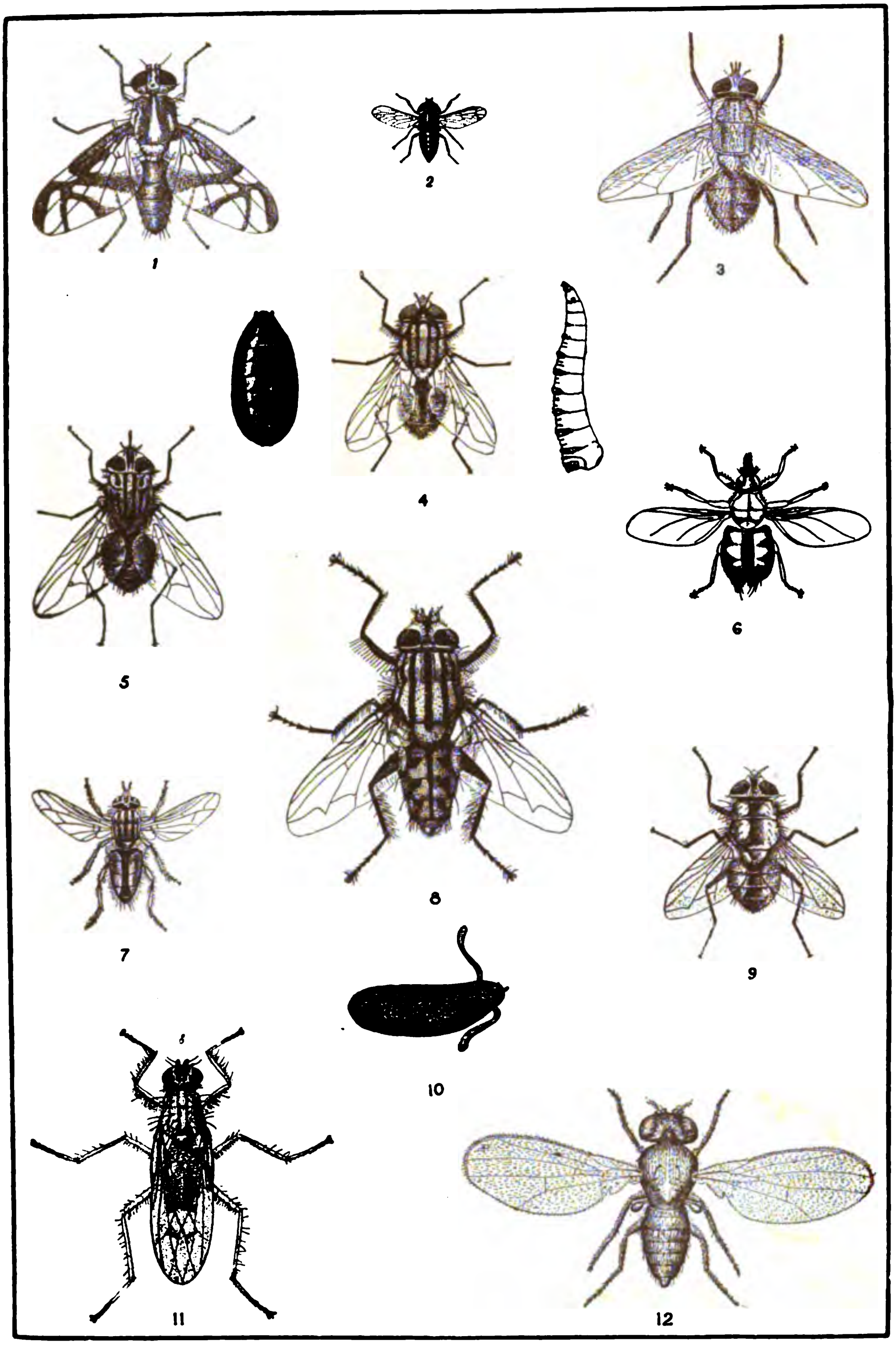
Flicker, one of the many local names of the North American golden-winged woodpecker (*Colaptes auratus*). This name, derived from one of the bird's characteristic calls, is coming into far more general use than formerly. A description of the bird will be found under WOODPECKER.

Flick'inger, Daniel Kumler, American bishop of the denomination of United Brethren: b. Sevenmile, Ohio, 25 May 1824. In 1857–85 he was corresponding secretary of the United Brethren Missionary Society, in 1885 became foreign missionary bishop, and in that capacity made 12 journeys in Africa. His publications, besides a volume of sermons, include: ‘Off-Hand Sketches in Africa’; ‘Ethiopia’; ‘The Church's Marching Orders’; ‘Our Missionary Work.’

Fliedner, Theodor, tā'ō-dōr flēd'nĕr, German Lutheran clergyman: b. Eppstein, Nassau, Germany, 21 Jan. 1800; d. Kaiserswerth 4 Oct. 1864. He became pastor in Kaiserswerth 1822. He gradually amassed in this poor parish an endowment fund for a church, school and poorhouse. In 1833 he founded an asylum for released female convicts, and in 1835 an infant school, at Düsseldorf, the earliest in Germany; a similar institution was organized by him at Kaiserswerth, the year following. In the same year he founded the Deaconesses' association, which was his greatest and most notable work. Among his writings, which are principally devotional and educational, may be mentioned ‘Das Buch der Martyrer.’

Flies, two-winged insects of the order *Diptera* (q.v.), whose larvæ are legless, soft, and eruciform, and are termed «maggots.» The

HOUSE, STABLE AND GARDEN FLIES



1 Apple-worm Fly. 2. Orange-belted Gadfly. 3. Horn-fly. 4. Common House-fly, with maggot and puparium. 5. Stable-fly. 6. Forest-fly or Bird-tick. 7. Meat-fly. 8. American Flesh-fly. 9. Green-bottle Flesh-fly. 10. Egg of Pomace-fly 11. Dung-fly. 12. Pomace-fly.

group is world-wide in its distribution, and probably quite as numerous as either the beetles, or the group of wasps, bees, ants, etc. It is now known to contain about 40,000 species, most of which are incalculably numerous in individuals; so that «swarms» of flies is a proverbial expression. Entomologists believe that 8 or 10 times 40,000 species really exist. This vast abundance is due to the plenitude of their food, and to their fecundity; and it is accompanied by a very high state of organization, so that certain families of flies are held by some students to stand at the head of the insect tribe in specialization of structure. Intellectually, however, they are far behind the *Hymenoptera;* and to this fact, to the small size and unattractive appearance of most specimens (although great brilliance of color is to be found among some families), and to the comparatively uniform and uninteresting nature of their metamorphoses, are to be charged the relatively small amount of study that has been given to the group. The life-history of the ordinary flies is detailed below; but many peculiarities exist in other families of the order. «With some,» says Howard, «no eggs are laid, and living larvæ issue from the body of the female. Such flies then become practically viviparous or ‹larviparous.› With others, although these are few in number, the development within the body of the female goes even farther, and when the insect emerges from the body of its mother it is already in the pupal condition. Such forms are called ‹pupiparous.› . . . Many species — comprising, in fact, whole families — are aquatic or subaquatic in their early stages, and some possess the faculty of living under what appear to be most disadvantageous conditions.» Some of the flies of the family *Ephydridæ* (whose eggs or larvæ are eaten by American Indians,— see AHUATLE; KOO-CHAH-BEE) live in the strongly alkaline lakes of the Far West where little else can exist.

Flies are mainly day-flies, and fond of sunshine, but some appear only at night or in the dusk; a section of the tribe does not fly at all, being wingless and parasitic. They live in the most diverse manner; some attack large animals and suck their blood; some prey on smaller insects; some suck honey, and in search of it take part in the cross-fertilization of flowers (see FLOWERS AND INSECTS); and many find their food in decaying animal and vegetable matter. A large number of dipterous' larvæ eat refuse or carrion,— whence arise serious evils to mankind,— others feed inside growing vegetables; and some maggots prey, or are parasitic upon, other animals.

A type of the group is found in the house-fly (*Musca domestica*), which represents the great family *Muscidæ,* in which most of the familiar flies about houses and stables are included, and its life-history represents that of its kind generally. Its eggs are laid preferably on horse-manure, but also on human or other excrement, decaying vegetables, etc., and hatch in six or eight hours, producing white maggots. These mature in four or five days, when their skins harden and turn brown, forming a puparium, or case, within which the true pupa forms, and five days later gives birth to a perfected fly. Thus a total life cycle requires in midsummer only about 10 days, and a dozen generations may thus be born in warm climates within a single season. As each fly deposits on the average 120 eggs, and as the maggots of 1,200 house-flies may be sustained by a pound of manure, the possible rapidity of their multiplication is apparent. Most flies live but a few weeks, and toward the end of the season they die with great rapidity, becoming infested with reddish mites, which suck their juices, or with fatal fungous diseases (see FUNGI). In warm houses a few may survive a winter, but as a rule all adult flies die in the fall, and the species survives and recovers in the spring from the eggs or pupa left over winter in the manure-heap or other feeding-place. It is plain that attempts to mitigate the annoyance and danger resulting from many flies may best be directed toward the destruction of their eggs and young. That such destruction is desirable and the duty of society is plain when one considers the vast amount of injury these insects may do. Many sorts attack vegetables and fruit, for example the hessian-fly, which is perhaps the most destructive insect in the United States, the apple-fly, the gall-flies, fruit-midges, potato-scab gnat, and others. Others harm domestic animals, as the bot-flies, sheep-ticks, horn-flies, tsetse, and all the horse-flies, bee-killing robber-flies and bee-flies, black-flies, mosquitoes, and many more. This catalogue of harmfulness (to which can be opposed only the beneficial work done by the tachina-flies which cause the death, by parasitism, of other kinds of injurious insects) becomes of small importance, however, beside the enormous evil flies do in spreading virulent diseases from man to man and place to place. Were this not so it might be true, as formerly alleged, that their services as scavengers, as parasites, and in the cross-fertilization of plants, balanced the damage caused by some, and left something to their credit.

Flies as Carriers of Disease.— Consideration of the habits of house-flies and their relatives will show how prone they are to feed upon excrementitious matter, and to be attracted to any decaying or purulent substance. When this is the product of wounds, sores or diseased bodies it is likely to contain the germs of disease; and these may be sucked into the blood or cling to the body of the insect. If, then, the fly alights upon a human being or a susceptible animal, and punctures the skin with its sucking proboscis (for ordinary flies do not «bite,» properly speaking), it is likely to leave in the puncture some of the germs it has fed upon, and so infect the person with the disease to which they give rise. Wounds may thus be inoculated with «blood-poison»; and certain diseases, grouped as «myiasis» may arise from taking into the stomach, in eating spoiled vegetables, minute flies (*Anthomyia*) breeding in them. Even vegetable diseases may be so transmitted, as is the case with the «scab» of potatoes, which, according to Hopkins, is spread from plant to plant by the visits of a fungus-gnat (*Epidapus scabiei*).

That this theoretical transmission of disease actually occurred has been demonstrated since the latter part of the 19th century by observation and experiment. It was first ascertained of certain mosquitoes, whose responsibility for much if not all of the malaria from which men suffer was shown. This may be found more fully treated under Mosquitoes (q.v.), where the agency of these small ubiquitous flies in spreading other diseases is also shown. Dr. Joseph Leidy attributed the spread of gangrene in the hospitals at Washington during the Civil War to the flies; a few years later it was shown that gadflies which had settled upon the dung of cattle afflicted with anthrax would communicate the disease to healthy kine. In 1888 an Italian investigator showed that flies fed upon a bacillus culture would drop virulent bacilli in their ordure, capable of infecting new cultures; further experiments in India showed that flies fed with a culture of the bacilli of bubonic plague and of Asiatic cholera survived and conveyed the plague to man. An English physician asserted that typhoid fever was spread by insects; and this was abundantly proved during the prevalence of that disease in the military camps during the Spanish-American war of 1898. Flies which have access to the excreta of patients and afterward alight upon food, so infect the food that whoever eats it is in danger of falling ill with the fever. Howard demonstrated that the common house-fly was the principal agent in this transmission. Subsequent investigations showed that the danger of the propagation by flies (and other household insects) was equally great in diphtheria and yellow fever. In another series of cases, as among mosquitoes, the fly acts as intermediary host for disease germs which develop in its blood to the point where they are virulent when introduced into the circulation of man or beast. Such is the case with the African tsetse fly (q.v.), which transmits a greatly dreaded cattle-disease. The purulent ophthalmia, known as "pink-eye," and particularly prevalent in the South, is facilitated by minute gnats of the genus *Hippelates*.

Dr. L. O. Howard, of the United States Department of Agriculture, has given special attention to this matter, and has found that no less than 77 species of flies frequent human excrement and are therefore liable to obtain and carry disease germs. As the innumerable insects themselves are beyond reach, the measures for protection must be preventive. Dr. Howard says that in order to avoid epidemics of typhoid fever it is necessary to abolish the box privy, prevalent in rural and village districts, and substitute earth-closets, where water-closets cannot be installed; to place stable manure in receptacles and treat it with chloride of lime to destroy the maggots, throwing a shovelful over each day's addition. Pantries, dining-rooms and kitchens should be carefully screened to keep out flies; and especial pains taken in summer to keep flies out of sick-rooms. Detailed instructions and the reasons for them are given by Howard in his pamphlet, 'How Insects Affect Health in Rural Districts,' issued as Farmers' Bulletin 155, by the United States Department of Agriculture.

Classification.— The classification of the *Diptera* has proved difficult. An early division was based on the structure of the antennæ: *Nemocera* — those having the antenna thread-like and with 6 to 36 joints; and *Brachycera*, those with the antenna three-jointed and bristle-like. A later and more widely accepted subdivision was based upon the way the pupa-case splits on emergence of the fly; in the *Orthorapha*, the pupæ escape from the larval skin through a T-shaped orifice; in the *Cyclorapha* the pupæ escape through a circular opening at the anterior end. American entomologists, following the special investigations of D. W. Coquillet, now usually divide the order into two sub-orders based upon the character of the mouth-parts, and characterized as follows:

Sub-order Proboscidea.— Antennæ conspicuous, inserted at upper end of the face, sometimes many-jointed, proboscis usually furnished with terminal lips, body rather soft and brittle, legs approximated, wings usually present and frequently furnished with a discal cell; adults oviparous or larviparous, never in all their stages living externally on mammals, birds, or honey-bees.

In this group are placed, in order, the following important families: *Tipulidæ* (crane-flies), *Culicidæ* (mosquitoes), *Cecidomyiidæ* (gall-gnats), *Mycetophilidæ* (fungus-gnats), *Simuliidæ* (black-flies), *Leptidæ* (snipe-flies), *Stratiomyiidæ* (soldier-flies), *Tabanidæ* (horse-flies), *Bombyliidæ* (bee-flies), *Asilidæ* (robber-flies), *Syrphidæ* (syrphus-flies), *Œstridæ* (bot-flies), *Tachinidæ* (tachina-flies), *Sarcophagidæ* (flesh-flies), *Muscidæ* (house-flies), *Anthomyiida* (fruit-flies), *Trypetidæ* (fruit-flies), *Ephydrida* (edible salt-water flies), and *Oscinidæ* (grass-stem flies); besides various less important ones. Each is more particularly described elsewhere in this work.

Sub-order Eproboscidea.— Antennæ usually inconspicuous, commonly inserted near the middle of the sides of the face, and composed of from one to three joints, the apex furnished with a style or bearing several long bristly hairs, proboscis never furnished with terminal lips, body integument tough and leathery, legs on one side of the body usually widely separated from those on the other side, wings, when present, never furnished with a discal cell; adults pupiparous, living externally upon mammals, birds or honey-bees.

This second sub-order comprises only two families, the parasitic bird-ticks (*Hippoboscidæ*) and the bat-ticks (*Nycteribidiidæ*), which owe their vernacular names to their resemblance to true ticks in appearance and habits.

Bibliography.— L. O. Howard's 'Insect Book' (New York 1901) contains the latest and most fully illustrated general account of the flies, and also a large list of books on the subject, especially those relating to systematic description. S. W. Williston has an excellent illustrated account in 'The Standard Natural History,' Vol. II. His 'Manual of American Diptera' (New Haven 1896); Comstock's 'Manual for the Study of Insects' (Ithaca, N. Y., 1895); Packard's 'Half Hours with Insects,' and 'Text-Book of Entomology'; and Miall's 'Natural History of Aquatic Insects' (1895), may be consulted with profit.

Flight. Flight, strictly speaking, is progress through the air in any desired direction by an agent or object heavier than the air, as opposed to the floating of an object lighter than the air, such as a balloon. Animals accomplish flight mainly by means of wings, which may be special organs as in the insects, or modified fore legs, as in the case of bats and birds. The wings of insects are always thin membranes supported by a stiffer framework. In bats they consist of extensible membranes stretched over the immensely elongated fingers and joined also to the sides of the body and the hind legs. The wings of birds are composed of long stiffened

REPRESENTATIVE FLIES.

feathers attached to the rudimentary fingers and to the bones of the forearm; the individual feathers overlapping one another so as to form a continuous more or less arched surface. The tail feathers constitute another sail area which plays an important part in flight, while in many bats a continuation of the flight-membrane between the hind legs has much the same function.

Besides these special organs the structure of aërial creatures is modified in many other respects with a view to facilitating flight. Thus the hollow bones of birds are lighter than the solid bones of terrestrial animals and relieve birds of much unnecessary weight; while the general shape of the bird's body and the smooth rounded contour of its feather covering are calculated to give the least possible resistance to the air during flight. Birds are also provided with large distensible air sacs under the skin, the function of which has been a matter of much dispute, but which, as suggested by von Leudenfeld, may aid in shifting the centre of gravity of the body, a matter of the utmost importance to the bird in holding to its course or in turning in flight. The centre of gravity, we may note, is also kept well below the plane of the wings by the distribution of the heavy parts of the body on the pectoral side. So that as the bird flies the heavy breast muscles, which constitute the bulk of its weight, are well down while the wings are attached to the back of the thorax. Thus the body becomes essentially a weight hung directly below an outstretched sail area.

So much for the general structure of flying creatures. Turning now to the principles of flight we have as the main agencies (1) the muscular propulsion on the part of the bird; (2) the support offered to the «sail area» by the air; (3) the force of the wind both in raising and in propelling the bird. Mechanical and physical problems are involved in the study of flight which it will be impossible to consider here, but one or two principles may be mentioned which are of fundamental importance, and the application of which may be seen in all forms of flight. We know that the resistance (that is, support) of the air to a flat surface is greatly increased when the surface is traveling rapidly through the air in its own plane, and it follows that when a bird is once on the wing the buoyancy of the air relative to it is greatly heightened; and having gained a certain momentum it will be possible for the bird to sail some distance without loss of altitude. Again when a flat surface is sailing diagonally through the air the maximum pressure (that is, support) of the air is not under the centre of the surface, but under the forward edge. It is on this principle that we find a tendency to force up the anterior edge of the wings of a sailing bird and in order to counteract it the bird is compelled to shift the centre of gravity of its body farther forward. To do this it may draw the wings back, spread the tail or perhaps extend the head and neck. On the same principle to turn the direction of flight it is merely necessary to flex or raise one wing or one side of the tail. Flight proper may be of two sorts, (1) by flapping the wings, and (2) by soaring. The former is the most familiar and is practised by all birds, while the latter is possible only for birds of large expanse of wing, such as vultures, eagles, gulls, etc.

In taking flight it is very important for the bird to «get a start,» as we say; that is, to acquire some relative velocity, and to accomplish this we often see birds which are about to fly run along the ground for a few steps or flap along the surface of the water, while starting head toward the wind with wings properly spread accomplishes the same result. Rising into still air by flapping is very laborious work and some heavy-bodied birds, as the loons, for instance, are utterly unable to take flight when confined within a small area.

When once in the air and fairly started in flight the wing action is far less laborious than at the start, and the upward stroke is often relative to the body only and not necessarily a muscular effort. When this stroke is active, the individual feathers, as instantaneous photographs show us, are more or less separated to reduce the resistance of the air on the recovery. Most birds mingle flapping and straight sailing in various ways, and when once on the wing flight is mainly a matter of presenting their sail area to the air currents in such a way as to gain the greatest benefit from them.

Soaring is flight in circles with set wings and without any visible muscular action on the part of the bird. In spite of this the bird is able to mount higher and higher in the air, gaining impetus enough on the flight with the wind to carry it above its initial altitude when returning on the other half of the circle against the wind. Many theories have been advanced to explain the «soaring bird,» some of them purely fantastic, but the true solution of the problem seems still to be lacking. Suffice it to say that this method of flight is possible only in the presence of currents of air, and that the unequal velocity of air at different altitudes doubtless has much to do with it.

Aëronauts naturally look to birds for suggestions in artificial flight, and the great superiority which they exhibit over the best flying machine so far constructed may be seen in Prof. Langly's comparison of his aërodrome which has repeatedly flown from a half to three quarters of a mile, with a condor. The machine with a weight of 30 pounds and a supporting area of 54 square feet is driven by an engine of one and a half horsepower, while the bird weighing 17 pounds has a sail area of only 9.85 square feet and a propelling power of but .043 horsepower. Birds vary very much in wing power according to their method of flight; the humming-bird and pigeon being abundantly supplied with wing muscles to maintain their rapid strokes, while the frigate-bird, a notorious «sailer,» is remarkably weak in muscular development. The speed of flying birds also varies greatly. The best flyers of which we have definite record are the carrier pigeons, which travel from 30 to 50 miles an hour, while an albatross, caught and tagged by sailors, was recaptured, according to Lucas, 12 days later, 3,150 miles distant.

Our familiar small birds do not travel at anything like such a rate, but their endurance is very great, as we can realize in view of their migrations, which often reach from the northern United States to equatorial South America, while the small waders travel from one end of the hemisphere to the other. See MIGRATION.

Flying creatures occur among mammals, reptiles, and fishes. The extinct pterodactyls were evidently experts on the wing, and some of them constituted the largest flying animals of which we have any record. Of mammals the bats are the only true flyers, the flying squirrels and lemurs having merely parachute-like expansions of skin on the sides of the body which when the legs are stretched out enable them to sail obliquely downward from the tree tops to the lower branches.

In the flying-fish (q.v.) there is an enormous development of the pectoral fins which simulate wings. Their flight, however, consists only of a short sail through the air on an impetus gained as they leap from the waves with the fins rigidly extended.

Consult: E. J. Marcy, 'Vol des Oiseaux' (Paris 1890); Prof. Chas. S. Roy, article 'Flight,' in 'Newton's Dictionary of Birds' (1896); Prof. S. P. Langley, 'The Greatest Flying Creature,' Smithsonian Report 1901.

Flightless Birds. Certain birds are quite unable to fly, or fly very poorly, or use their wings only as paddles or balancers, or in extreme cases have lost not only the use of wings, but the wings themselves have disappeared. Examples of this degeneration will be found treated of in the articles upon APTERYX; DODO; GAREFOWLS; MOA; OSTRICH; PENGUIN; RATITÆ; SOLITAIRE.

Flinch, a card game said to have had its origin in Kalamazoo, Mich., and to have been invented by a man named Flinch. The game is played with a pack of 150 cards, numbered consecutively from 1 to 15, there being 10 cards of each numeral. All are of the same color; there are no hearts, diamonds, clubs or spades, and the court cards, are, of course, also missing. The cards are shuffled, and 10 cards are dealt to each player for his flinch pile, then 5 more to each to play with. Each player must place his flinch stack face up, with only the top card exposed. The other five cards are kept in hand, spread out like a fan to see the numbers, for flinch has not as yet the dignity of indexed-edged cards. The object of the game is to get rid of the flinch pile, and whoever first succeeds wins the game. To this end the flinch pile must be played from whenever possible. When this is not done, the opponent will call «flinch,» and the player will have to draw a card from the opponent's flinch pile and place it on the bottom of his own. In case two or more of the opponents call «flinch» at the same time, the negligent player must draw a card from the pack. The game may be played by any number from two to eight. After shuffling, the entire pack is usually stacked up criss-cross into hands of five, to facilitate drawing new hands.

Flinck, Govaert, Dutch painter: b. Cleves 25 Jan. 1615; d. Amsterdam 2 Feb. 1660. At Amsterdam, where he took up his permanent residence, he became a pupil of Rembrandt, whose manner and technique he so closely imitated that he comes nearer to the master than any other of his pupils, with the exception of Eeckhout. He was much sought after as a portrait painter, and has also left many religious pictures and a few genres, such as 'Die Wachstube,' which is equally Rembrandtesque in subject, conception and treatment.

Flind'ers, Matthew, English navigator: b. Donington, Lincolnshire, England, 10 March 1774; d. London 19 July 1814. He did much toward mapping out the coastline of Australia. In his first voyage of discovery he started in 1795 from Port Jackson, and skirting the southeast coast reached Van Diemen's Land. In a subsequent voyage of discovery, on which he was despatched by the British government with but poor equipment, he sailed along the south coast to Cape Leeuwin, and the bay which now bears his name. He next explored the east coast of Australia, from Port Stephens to Cape Palmentone; threaded the formidable Barrier Reefs, and coasted the Gulf of Carpentaria. Then turning back he made for Europe, by way of Sydney. He was shipwrecked on this voyage and detained by the French in Isle de France for seven years. From the effects of this imprisonment he never recovered. On his arrival home he published 'A History of Terra Australis.' The coast of South Australia was long called after him Flinders Land. His name is still attached to the southernmost county in Eyre Peninsula, and to Flinders Island, off that coast; to the Flinders Range in South Australia, rising near the head of Spencer Gulf, and running north (highest peaks, 3,100 feet); also to a town in Victoria, 61 miles southeast of Melbourne. See Life by Thynne (1896).

Flinders-Petrie, William M. See PETRIE, WILLIAM MATTHEW FLINDERS.

Flindersia (named after Captain Matthew Flinders), a genus of trees of the order *Meliaceæ,* allied to the mahogany, to which, however, it is generally inferior. The trees of this genus are tall, with a correspondingly great diameter, and furnish large quantities of valuable timber. *F. australis,* the Queensland ash, is used in Australia for staves, etc.; *F. oxleyana* is a hardwood tree yielding excellent material for cabinet-work, and also furnishing a yellow dye. The wood of *F. greavesii* is used in housebuilding, for which it is well adapted by its durability.

Flint, Austin, American physician: b. Petersham, Mass., 30 Oct. 1812; d. New York 13 March 1886. He was graduated at the medical department of Harvard College in 1833. After practising in Northampton, Mass., Boston, and Buffalo, where he established the Buffalo 'Medical Journal' in 1846, he was one of the founders, and for six years a professor, of the Buffalo Medical College. He was a professor in Louisville University 1852-6; professor of pathology in the Long Island College Hospital in 1861-8; president of the New York Academy of Medicine in 1872-5, and of the American Medical Association in 1884. He was the author of numerous text-books, clinical reports and medical papers.

Flint, Austin, American physician, son of the preceding: b. Northampton, Mass., 28 March 1836. He was graduated from the Jefferson Medical College, Philadelphia, 1857, and removing to New York in 1861 became professor of physiology in Bellevue Hospital Medical College, and surgeon-general in 1874. He has published 'Text-book of Human Physiology'; 'Physiology of Man; 'The Source of Muscular

Power›; ‹Chemical Examinations of Urine in Disease›; etc.

Flint, Grover (originally **Flint Grover**), American writer: b. New York 27 June 1867. He was graduated at Harvard in 1888 and from 1892-4 served in the United States army as cavalryman. In 1896 he went to Cuba and served with a Cuban insurgent army, and returning to the United States, some months later, married a daughter of John Fiske (q.v.). He served in Cuba in the Spanish-American war and subsequently went to the Philippines as a lieutenant of volunteers. He has published ‹Marching With Gomez, With Historical Introduction by John Fiske› (1898).

Flint, Timothy, American author: b. North Reading, Mass., 11 July 1780; d. Salem, Mass., 16 Aug. 1840. He was a Congregational minister during 1812-4; subsequently he devoted himself to editorial work, descriptive writing, and fiction. In these departments his most important work is included in: ‹The Geography and History of the Mississippi Valley›; ‹Indian Wars in the West›; and ‹Francis Berrian›; ‹George Mason;› and ‹The Shoshone Valley.›

Flint, Weston, American librarian: b. Pike, N. Y., 4 July 1835; d. Washington, D. C., 6 April 1906. He was graduated at Union College in 1860, and at the law department of Columbia University in 1877. He was United States consul to China 1871-4; librarian of the Scientific Library, United States Patent Office, in 1877-87; and was appointed librarian and secretary of the board of trustees of the Public Library in Washington in 1898. His publications include: ‹Catalogue of the Library of the United States Patent Office› (1878); ‹Catalogue of Additions to the Library of the United States Patent Office, 1878-82›; and ‹Statistics of Libraries in the United States, Canada, and Washington› (1893).

Flint, Mich., a city and county-seat of Genesee County, on the Flint River and on the Chicago and Grand T. and the Flint and P. M. R.R.'s; 64 miles northwest of Detroit. Flint has a court-house, the State Institution for the Deaf and Dumb, a private retreat for the insane, a high school, waterworks, gas and electric lights, public library, a national bank, and several daily, weekly, and monthly periodicals. It has saw-mills, carriages and wagon factories, flour- and woolen-mills, bicycle-works, brewery, etc., and many new and extensive plants for the manufacture of automobiles. Pop. (1910) 38,550.

Flint, or **Flintshire,** North Wales, a maritime county having on the north the Irish Sea and on the east the river Dee and Cheshire, with the county of Denbigh on the west. Its area is 256 square miles, and it is the smallest county in Wales. The low and sandy coast becomes fertile along the estuary of the Dee. A range of hills running parallel to the Dee rises in the highest part to 825 feet. The Carboniferous rocks underlie Flintshire, and the chief minerals are coal, iron, copper, lead, zinc, and limestone. Mining is the principal industry, and there are some manufactures of cotton, pottery, chemicals, etc. The chief towns are Flint, St. Asaph, Mold, Holywell, and Hawarden.

Flint, Wales, a market town and seaport, in Flintshire, 13 miles southwest of Liverpool. It has a handsome parish church in the Gothic style, erected in 1848. Near the town, on the shore of the estuary, stands the ancient castle of Flint, an object of some historical interest. It was completed by Edward I., and was the prison of Richard II. It has remained in ruins since 1667. Flint is on the Chester and H. R.R. Pop. about 5,000.

Flint, a massive variety of quartz, somewhat resembling chalcedony, but more opaque, and commonly of a gray or smoky-brown color, darker in the interior than on the surface. It occurs abundantly in the United States and in various other parts of the world. In England and France it occurs chiefly in the chalk formations, and a microscopic examination of it often shows the remains of diatoms and other minute organisms, from whose silicious skeletons the silica of the flint was doubtless largely derived. In other cases the flint was probably formed by the replacement of lime by silica held in solution by the ground water. The coloring matter of flint is chiefly carbonaceous matter, with some iron sesquioxide. Flint was used for many ages in the manufacture of stone implements, a use for which it is well adapted by its hardness, and also from the fact that it breaks with a conchoidal fracture, leaving sharp cutting edges. Previous to the invention of matches, flints were greatly used for the production of fire, the flint being struck repeatedly against a piece of steel, from which it detached small particles that were rendered red-hot by the friction. These were caused to fall into a mass of very dry and highly inflammable matter, known as "tinder," which took fire from them as dry grass beside a railroad takes fire from the sparks of passing locomotives. Before the invention of the percussion cap, flints were also used on musket locks, for igniting the powder.

Flint Glass. See Glass.

Flint Implements, tools, weapons, etc., made of silicious or flinty stones; a term particularly denoting implements used by man before the use of metals. See Stone Age.

Flint Mill, (1) In pottery, a mill in which burnt flints, having been previously stamped to reduce them below a certain size, are ground to powder for mixing with clay to form slip for porcelain. The flint-mill is a strong circular pan 10 or 12 feet in diameter, having a bottom of quartz or feldspar blocks, and a runner or runners of hard silicious stone, called chert, lime in any form being inadmissible, as it forms a flux for the other material which would vitrify in the seggars or become blistered by the escape of carbonic acid. (2) In mining, a mode formerly adopted for lighting mines, in which flints studded on the surface of a wheel were made to strike against a steel, the blows producing a quick succession of sparks, which lighted the miner at his work.

Flint River, one of the largest rivers in Georgia, rising near Atlanta and flowing 300 miles to the Gulf. It drains an area of 8,000 square miles.

Flintlock, the old-fashioned lock for firearms, in which the cock held a piece of flint, and came glancing down upon the steel cap of the pan which contained the priming. See Firearms; Musket.

Floating Battery, a vessel strengthened so as to be shot-proof, or as nearly so as possible, and intended for operating in comparatively smooth water, for defending harbors or attacking fortifications. The most notable attempt to make use of floating batteries against maritime fortresses, till the time of the Crimean war, was during the siege of Gibraltar in 1782, when batteries of this description, invented by the Chevalier d'Arçon, were employed at first with considerable effect. On this occasion, however, they turned out in the end a complete failure, being destroyed by the red-hot shot directed against them from the fort. After this failure no more attention was paid to them until Napoleon III. suggested the use of floating batteries, protected by iron plates, in attacking the Russian fortresses in the Black Sea and the Baltic. The suggestion was actually carried out, and the floating batteries then constructed proved very effective in 1855, during the operations against Sveaborg and Kinburn, as well as on subsequent occasions.

Floating Bridge. See BRIDGE.

Floating Docks. See DOCKS.

Floating Fern. See *Filicales* (4), under FERNS AND FERN ALLIES.

Floating Gardens. See FLOATING ISLANDS.

Floating Houses, abodes so constructed as to be movable at will upon the surface of a river or other water. Floating houses form whole streets in Bangkok, being anchored in rows and capable of being moved from one position to another. From the depth of water, large vessels of from 200 to 300 tons burden can sail up to this picturesque town and pass alongside the houses of the inhabitants. These floating houses are made of bamboo stems, wicker-work, and palms, with a veranda in front; and they are built on large rafts. See BANGKOK.

Floating Islands, islands formed either by the aggregation of driftwood in rivers and the deposition thereon of soil and vegetable matter, or by the detachment of portions of a river-bank or lake-shore. Tall trees are sometimes seen standing erect on such islands as they are carried down by the river current. Floating islands are sometimes seen 50 or 100 miles distant from the mouth of the large rivers of America, Asia and Africa. Portions of the alluvial soil from river-deltas, held together by the roots of mangroves and other trees, are sometimes detached by hurricanes or typhoons and then swept out to sea; such islands have been met with in the Philippines, in the seas of the East Indies, and in the Pacific. A floating island is mentioned by Herodotus as existing in Egypt. Others were known to Roman writers. Those on Lake Vadimona were, according to the younger Pliny, capable of supporting sheep. Loch Lomond in Scotland long possessed a floating island, which has now, however, disappeared or become attached to one of the stationary islands of the loch. In Ireland large masses of peat float about some of the bogs. In England, in Lake Derwentwater, there is an instance of an island which appears and disappears from time to time in the same spot. Perhaps the most satisfactory of the many theories which have been proposed to account for this phenomenon is that which attributes its rising from the bottom of the lake, where it ordinarily rests, to the permeation of its mass by marsh-gas during hot weather, the upward motion being assisted by the growth of buoyant water-plants on its surface. Between 1696 and 1829, similar islands were observed at irregular intervals, generally, however, after great droughts and violent storms, in Lake Rålang in the Swedish province of Småland. Oceanic floating islands sometimes perform important service in the transportation of vegetable seeds from place to place, also in the distribution of animal species, by carrying insects, land mollusca, and small mammalia, more rarely reptiles. Darwin met with islands floating on Lake Tagua-Cagua in Chile which passed from side to side of the lake and carried cattle and horses as passengers. In Northern India, and on the borders of Tibet, and Persia, floating gardens are often erected by the natives, for the purpose of raising melons, cucumbers, and other similar vegetables and plants, which require a very aqueous soil for their cultivation. These gardens, however, are of a very fragile nature, and rarely exceed a foot in depth of soil, their prime structure being composed of wicker-work, interlaced with reeds and wattles, and covered with matting, over which the earth is placed. In the Vale of Cashmere the lakes contain floating gardens devoted to the same purpose, but these are in reality portions of the marshy ground made to float artificially by cutting through the roots of the reeds and other plants about two feet below the surface. The Chinese, too, devote considerable attention to this style of horticulture, but more by way of ornamentation. Floating gardens, or *chinampas,* also existed in Mexico before the Spanish conquest. Clavigero describes them as formed of wicker-work, the stems of water-plants, and mud, the largest sometimes having on them a tree or a hut. Both flowers and vegetables were grown on them.

Floats. (1) In angling, the quill or cork from which the bait line is suspended, and whose motion indicates the bite of a fish. (2) An inflated bag or pillow to sustain a person in the water. (3) The small piece of ivory on the surface of the mercury in the basin of a barometer. (4) The hollow, metallic ball of a self-acting faucet, which floats on the water in the cistern or boiler. (5) A raft, or collection of timber fastened together for conveyance down a river. (6) In hydraulic engineering, one of the boards or paddles attached to the radial arms of a paddle wheel or water wheel. (7) In machinery, a single-cut file, or one in which the teeth are parallel and unbroken by a second row of crossing teeth. The usual horizontal obliquity of the teeth relatively to the central line of files is 55°, but single-cut files are much less inclined, and the teeth of floats are sometimes square across the face of the file. (8) In plastering, a plasterer's trowel used in spreading or floating the plaster on to a wall or other surface. The long-float is of such a length as to require two men to use it. The hand-float is that in ordinary use. The quirk-float is used in finishing moldings. An angle-float is shaped to fit the angle formed by the walls of a room. (9) In masonry, a polishing-block used in marble working; a runner. (10) In shoe making, the serrated plate used by shoemakers for rasping off the ends of the pegs inside the boot or shoe. (11) In tempering, a contrivance for affording a copious stream of water to the heated steel surface of an object of large bulk, such as an anvil or die in the process of tempering. The rapid production of steam prevents the constant contact of cold water when the object is merely dipped, as a body of steam intervenes. The dashing stream of water constantly exposes a new body of water to the hot surface, and makes the hardening more complete. (12) Theatrical: A stage name for the footlights, derived from the use of a row of oil-pans, with floating wicks, along the stage-front, previous to the invention of gas.

Float-stone, a variety of opal, or hydrated silica, occurring in concretionary masses of such a porous texture that they float on water. They are of a gray or white color, break with uneven fracture, and sometimes have a hard nucleus of a flinty appearance.

Flodden, flod'n, a village in Northumberland, England, about five miles southeast of Coldstream, near which was fought the celebrated battle in which James IV. of Scotland was defeated by the Earl of Surrey (9 Sept. 1513). See SCOTLAND.

Floe-rat. See SEAL.

Flogging, the infliction of stripes or blows with a whip, lash, or scourge, especially as a judicial punishment. In Britain it long existed as a punishment in the army and navy; but it was totally abolished in the former in 1881, and in the latter it is practically extinct. It was made a punishment for certain violent crimes, such as garrotting, in 1863; and for juvenile offenders in 1847 and 1850. In these cases, however, the number of stripes is limited by law, 50 being the maximum in some instances, 25 in others, and so on. A judge in sentencing a prisoner to flogging must specify the instrument and the number of stripes. In the case of juveniles under 14 years of age the instrument must be a birch rod, and the number of stripes must not exceed 12. The punishment of the knout in Russia and of the bastinado in the East are severe forms of this punishment. In the United States, flogging was discontinued in the navy and on merchant vessels in 1850. In the army, it was abolished 1861. As a means of prison discipline, it has been used till very recently, and its disuse is a subject of debate. For the subject of its use as a legal punishment for certain offenses, see FLAGELLATION; WHIPPING-POST.

Flood, flud, **Henry**, Irish orator and politician: b. near Kilkenny 1732; d. Farmky, county Kilkenny, Ireland, 2 Dec. 1791. He was educated at Trinity College, Dublin, and Christ Church, Oxford, entered the Irish parliament in 1759, and soon became the most prominent and eloquent member of the popular opposition. He was privy councilor for Great Britain as well as for Ireland in 1775, and vice-treasurer for Ireland 1775-81. In 1783 he had a personal dispute in the house with Grattan, when a remarkable display of the power of invective was made on both sides. He afterward became a member of the British Parliament for Winchester and Seaford. His speeches were published in 1787. See Lecky: 'Leaders of Public Opinion in Ireland' (1872).

Flood, Theodore L., American Methodist clergyman: b. Williamsburg, Pa., 20 Feb. 1842. He served in the Federal army in the Civil War, entered the Methodist ministry, and after an active pastorate of 15 years became connected with the Chautauqua movement. He edited the Chautauqua Assembly 'Herald,' which began its monthly issue at Meadville, Pa., in 1877, and became 'The Chautauquan' in 1880. He retired from its editorship and ownership in 1899. He has been active in various denominational and commercial enterprises and was an unsuccessful Republican candidate for Congress in 1892.

Flood Plain, the plain formed by a river in broadening its valley. The first work done by a river is to cut a trench-like valley, this having been cut so deeply that the slope of the river-bed toward the sea so slackens the current of the river that it cannot carry its load of detritus, this detritus is partly dropped. Then the upbuilding of the river channel causes the river current to swing from side to side. In this way first one side, then the other of the valley is attacked by the river. In time of flood the plain of waste thus accumulated may be entirely covered by the swollen river. The flood plain of the Mississippi west of Tennessee is 50 miles wide. See RIVER; VALLEY.

Floods and Inundations are caused by excessive rains, giving rise to an overflow of the rivers; by the bursting of the banks of rivers, lakes, and reservoirs; by the sudden melting of ice and snow; and by irruptions of the sea, produced by high tides, wind-storms driving the sea-water inland, earthquakes, volcanic outbreaks, and the bursting of sea banks. The felling of forest trees throughout extensive tracts of mountainous country also tends to make the rivers which have their origin there swell rapidly after a heavy rainfall; good and complete drainage of land has the same tendency. (For the Noachian flood, see DELUGE.) The subjoined list embraces some of the most disastrous floods and inundations of which we have record.

684 A.D. Japan; 780 sq. m. of Isle of Shikoku covered by sea.
968. Persian Gulf; many cities destroyed and new islands formed by irruption of sea.
1014. Many English seaports destroyed by sea.
1098 or 1100. East of Kent inundated; Goodwin Sands formed.
1100 or 1108. Flanders inundated.
1161 or 1165. Sicily; irruption of sea; thousands drowned.
1170. Holland and Friesland; great flood.
1173. Holland; Zuyder Zee much enlarged.
1219. Nordland, Norway; lake burst; 36,000 people perished.
1228. Friesland; invasion of sea; 100,000 people drowned.
1277. Friesland; the Dollart formed.
1286–7. Holland on both sides of Zuyder Zee inundated in consequence of a storm.
1396. Holland; islands of Texel, Vlieland, and Wieringen separated from mainland, and Marsdiep, the channel between Texel and North Holland, formed.
1421 or 1446. Holland; 72 villages inundated, of which. 20 permanently, about 100,000 persons drowned, Biebosch formed east of Dordrecht, and this town separated from mainland.
1521. Holland; 100,000 lives lost by an inundation.
1570. Holland; storm drove in the sea, destroying numerous villages and 20,000 people in Friesland.
1617. Catalonia, Spain; 15,000 perished in floods.
1629. Mexico (city) inundated.
1642. China, at Kaifong; 300,000 drowned.
1646. Holland and Friesland inundated; loss of life, 110,000.
1726. Floods and inundations all over Europe.
1745. Peru; Callao destroyed by irruption of sea caused by earthquakes.
1767. England; irruption of sea on east coast.

1782. Formosa; west side of island submerged, and Taiwan destroyed.
1787–8. India, in Northwestern Provinces and Punjab; 15,000 lives lost by floods.
1791. Cuba; floods from excessive rain; 3,000 drowned.
1811. Hungary; 24 villages swept away by overflow of Danube.
1813. Austria, Hungary, Poland, and Prussian Silesia; floods caused by rains; 4,000 perished in Poland, 6,000 in Silesia.
1824. St. Petersburg and Cronstadt; 10,000 lives lost from overflow of Neva.
1825. Denmark; sea broke through from North Sea to Limfjord making northern Jutland an island; one third of Friesland submerged.
1840. France; overflow of Saône and Rhone swept away many villages and inundated Lyons, Avignon, Nîmes, Marseilles, etc.
1851. Northern China; Yellow River burst its banks, and made a new outlet into Gulf of Pechili.
1852. Floods throughout Europe from Belgium to Switzerland.
1856 South of France; floods did damage to extent of $28,000,000.
1868. Peru; Arica and Iquique nearly destroyed by earthquake waves.
1874. United States; Mill River valley (Mass.) inundated by bursting of a dam; 144 drowned. Also floods in western Pennsylvania; 220 drowned.
1875. Disastrous floods throughout central Europe, in United States, Burma, India, and West Indies.
1876. China floods in northern provinces; in Bengal 200,000 persons perished from inundation of a tidal wave.
1883. Java and Sumatra; parts submerged by volcanic wave. (See Krakatoa.)
1887. China; the Hoang-ho in Ho-nan; millions of lives lost.
1889. Johnstown, Pa.; reservoir burst; 2,209 lives lost.
1891. Consuegra Spain; 1,200 lives lost.
1893. Queensland; great destruction of property.
1896. Japan; 27,000 lives lost.
1900. Galveston, Tex.; 6,000 lives lost and 3,000 buildings destroyed.
1903. Kansas City, Mo., and Mississippi River towns; millions of dollars in property destroyed.
1903. Heppner, Oregon; cloudburst; 300 lives lost.
1910. Paris, France; rising of Seine; loss of property $200,000,000; loss of lives unknown.
1910. Anram; 1,000 lives lost.
1911. Austin, Pa.; 100 lives lost.

Floor. (1) In building, the surface on which a person walks in a room or house. It may be of masonry, bricks, tiles, concrete, earth, boards. The term usually refers to boards laid close together and nailed to timbers which are termed joists. (2) In geology and archæology, the part of a cavern corresponding in situation to the floor of a house. Here frequently there is now cave earth, covered, and therefore hermetically sealed for the purpose of the investigator, by stalagmite, which has been formed by droppings, from the stalactites hanging from the roof. (3) As a nautical term, the bottom part of the hold on each side of the keelson; the flat portion of a vessel's hold. (4) In hydraulic engineering, the inner piece of the two which together form the bucket of an overshot water wheel. (5) In mining, the bottom of a coal seam; the underlay on which the coal, lead, or iron ore rests. (6) To take the floor: To rise to address a public meeting.

Floor-cloth, or **Oil-cloth.** The basis of floor-cloth is a strong, open canvas, woven of flax, with a slight admixture of hemp. Owing to its great width, 6 to 8 yards, it has to be woven in special looms. It is made in lengths of from 100 to 113 yards. A length of 60 to 100 feet is stretched in a frame, brushed with glue-size, and rubbed with pumice-stones. It then receives two or three foundation coats of paint on each side. This is a thick paint, commonly made of linseed oil and ochre, and is laid on with a trowel. Each coat on the front is smoothed with pumice-stone. When this operation is completed the cloth is transferred to the printing-room, where the pattern is printed by blocks, as in calico-printing. There is a block for each color.

Floquet, Charles Thomas, sharl tō-mä flō-kā, French statesman: b. St. Jean de Luz 5 Oct. 1828; d. Paris 18 Jan. 1896. He began life as a lawyer in Paris, where he defended the Republican journalists. On the fall of the empire he was appointed one of the deputy mayors of Paris, but was forced to resign on account of his complaisance toward the Red Republicans. Later he was elected to the Paris municipal council and in 1876 became one of the deputies for Paris. He sat in the Chamber till 1882, when he was appointed Prefect of the Seine; re-entered the Chamber in 1882 and was elected its president in 1885, but resigned in April 1888, to become prime minister. In 1889 he was again elected president of the Chamber. He aspired to the presidency of the republic, for which office he was the Radical candidate in 1887; but his career was cut short by the Panama Canal scandal, and he lost his seat in the elections of 1893.

Floquet, Pierre Amable, pē-är ä-mäbl, French historian: b. Rouen, France, 9 July 1797; d. Formentin 6 Aug. 1881. He made Normandy's annals and personages the objects of his painstaking study in ‹Norman Anecdotes›; ‹History of the Parliament of Normandy› (1840–3); and ‹Studies in the Life of Bossuet› (1855), the last two of which were crowned by the Academy.

Flo'ra, the Roman goddess of flowers and spring, whose worship was established at Rome in the earliest times. She is represented as a beautiful female, with a wreath of flowers on her head or in her left hand; in her right hand she generally holds a cornucopia. Her temple at Rome was situated near the Circus Maximus, and her festival, the Floralia, was celebrated from 28 April to 1 May. The later Romans identified Flora with the Greek goddess Chloris. In botany Flora signifies the plants of a region collectively, as Fauna signifies the animals. In astronomy an asteroid discovered by Hind, 18 Oct. 1847.

Flore'al, flō-rā-äl («month of flowers»), the eighth month in the calendar of the first French republic (1794). It began 20 April and ended 20 May. See Calendar.

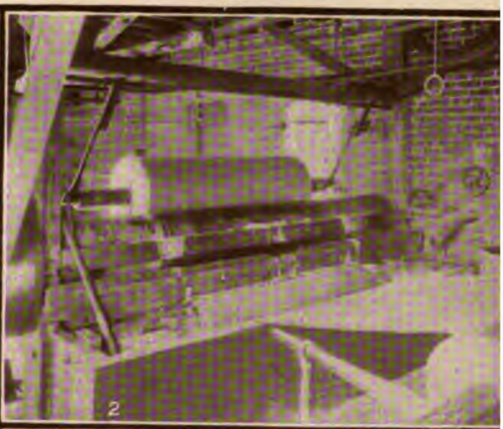
Flor'ence, William Jermyn (stage name of Bernard Conlin), American comedian: b. Albany, N. Y., 1831; d. Philadelphia, Pa., 1891. He began his career as an actor at Brougham's Lyceum, N. Y., in 1850, and soon became a great favorite with the public, especially in such characters as ‹Bob Brierly›; ‹Sir Lucius O'Trigger,› which latter he played to Joseph Jefferson's ‹Bob Acres› with great success in a series of joint performances during the last two years of his life. He was the author of several Yankee and Irish plays.

Florence of Worcester, English chronicler: d. 1118. He was a monk of Worcester, wrote ‹Chronicon and Chronicis,› a compilation from Marianus, an Irish monastic chronicler, which is of the highest authority in early British and Irish history.

Florence, Ala., a city and county-seat of Lauderdale County, on the Tennessee river, and on the Memphis and C., the Louisville, and the

MANUFACTURE OF OIL-CLOTH

1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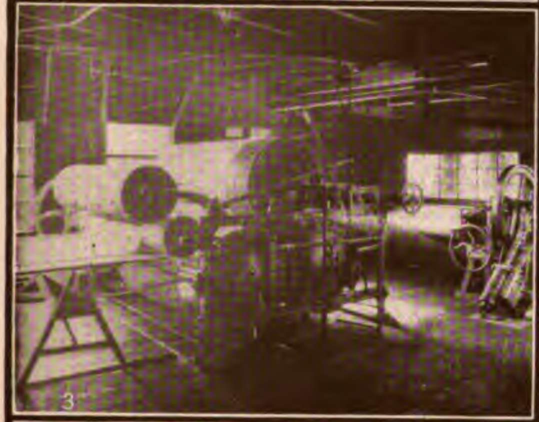
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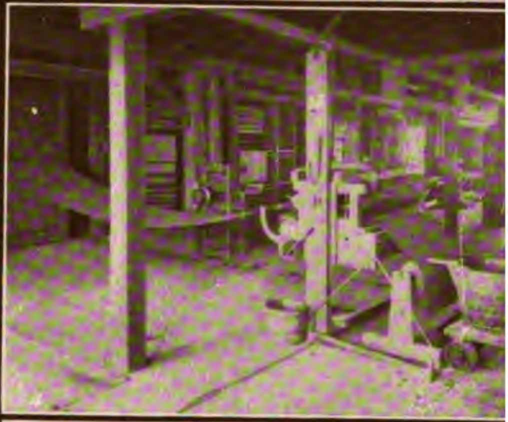
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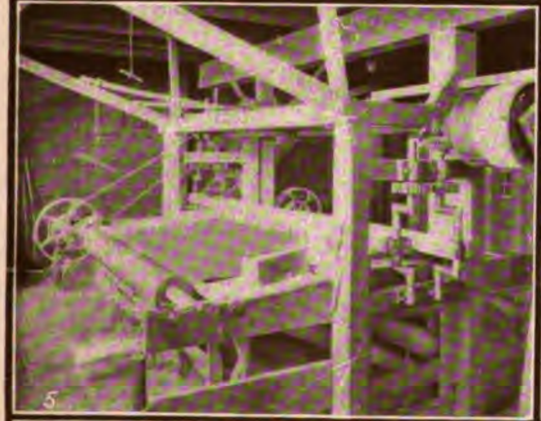
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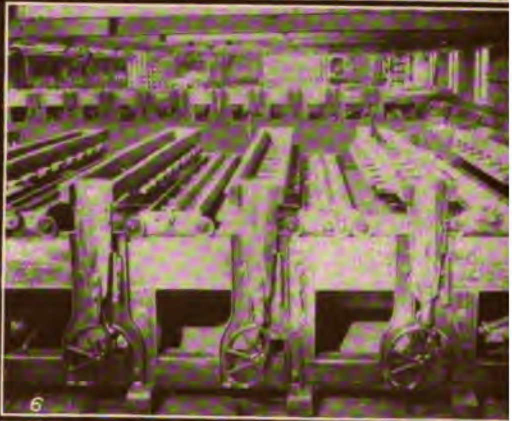
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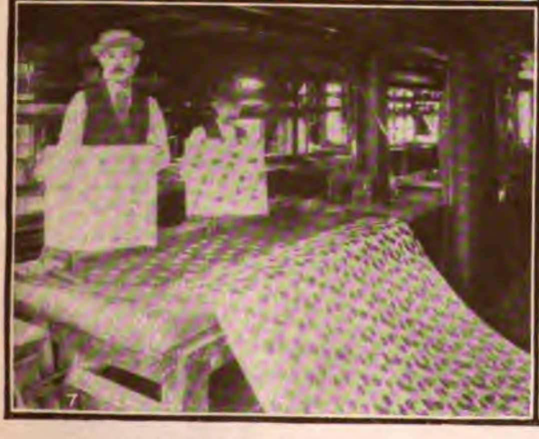
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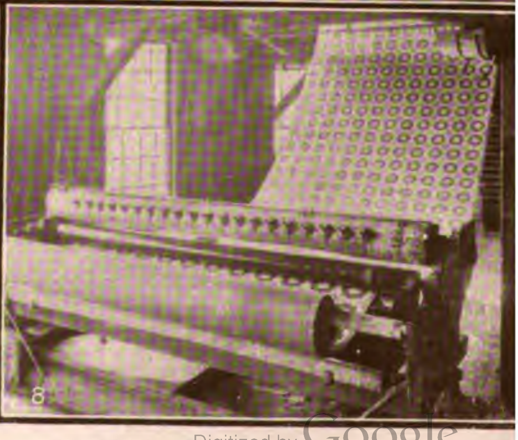
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1. Fire Wall and Railroads.
2. Sizing Machine.
3. Calender End of the Sizing Machine.
4. Painting Machine and Drying Racks.
5. Rubbing Machine.
6. Printing Machine Running Nine Colors.
7. Hand Printing a Mosaic Pattern.
8. Varnishing the Printed Oil-Cloth.

Nashville R.R.'s. Here are the Florence Synodical Female College, the State Normal College, Mars Hill Academy, Florence Institute, Paxton high school, a Congregational school, several churches, and a number of weekly newspapers. The city has manufactories of iron, cotton, wagons, ice, flour, stoves, etc., and an assessed property valuation of over $2,000,000. Pop. (1910) 6,689.

Florence (in Italian, *Firense*), a province of Italy; area, about 2,262 English square miles. The surface is beautifully diversified by mountains, valleys, and plains. The climate is generally mild and healthy, and the soil very fertile, producing wheat, maize, beans, and all kinds of leguminous crops. The vine, olive, orange, citron, and fig thrive well in the low grounds; while the mountainous districts afford excellent pasture, admirably adapted for the rearing of sheep. The minerals include mines of copper, lead, and mercury; and quarries of marble, alabaster, and fine building stone. Pop. about 950,000.

Florence (Italian, *Firense*), a famous walled city of central Italy; on both sides of the Arno, 187 miles northwest of Rome. It stands in a richly wooded, well-cultivated, and beautiful valley, encircled by the Apennines. Its shape is nearly a square, the sides of which almost correspond with the cardinal points; the Arno intersects it from southeast to northwest, three of the quarters into which it is divided being situated on the right, and the fourth on the left bank of the river. The communication between the opposite sides of the river is maintained by means of seven bridges. Florence contains a great number of magnificent edifices and squares, generally adorned with statues, columns, or fountains; there are no fewer than 170 churches, 89 convents, 2 royal, and many other palaces, 12 hospitals, and 8 theatres great and small. Each angle of a street presents an architectural view fit to be drawn for a scene in a theatre. Many of the houses are palaces, fitted up with great magnificence, and some of them contain valuable galleries of pictures. The streets are mostly wide and straight; and they are admirably paved with angular blocks of sandstone.

The Piazza Reale is the largest square; it has a fine marble fountain, and an equestrian statue in bronze of Duke Cosmo I., by John of Bologna. The Piazza del Mercato Vecchio, in the centre of the city, has a marble column from which Florence radiates for one mile on each side. The Arno is decidedly superior to the Tiber at Rome. The bridge Santa Trinita, built of marble in 1559 by Ammanate, is designed in a style of elegance and simplicity unrivaled by the most successful efforts of modern artists. The bridges, and quays by which the river is bordered, afford fine views of the river, Florence being in this respect much superior to the "Eternal City." The duomo, or cathedral, a vast edifice, coated with marble, about 500 feet in length, and 384 feet in height to the top of the cross, stands in a spacious square. The church of Santa Croce, called the Pantheon of Florence, is interesting from its containing the remains and tombs of four of the greatest men of modern Italy, or indeed of modern times — Michelangelo, Galileo, Machiavelli, and Alfieri. Among the palaces are the Palazzo Vecchio, or Old Palace, inhabited by the Medici when citizens of Florence, which was begun in 1298, and finished in 1550. It is in a massive, severe, and gloomy style, with a tower 268 feet high, and is now occupied by the principal public offices. Adjoining it is the Piazza del Palazzo Vecchio, a square containing a fine collection of statues, and a noble arcade, the Loggia di Lanzi, under the porticoes of which are magnificent groups of sculpture. The Palazzo Pitti, erected in 1440, the ordinary residence of the king of Italy, is a vast and heavy structure; it is furnished in the most costly manner, and is enriched with a great number of the choicest works of art and vertú and an excellent library. Attached to this palace are the Boboli Gardens, laid out by Cosmo I. in 1550, in the classical style. Connected with these gardens is the botanical garden, a museum of natural history, the Fontana anatomical collection in wax, etc. Another fine palace, the Riccardi (built in 1440), has a noble gallery with a ceiling painted by Luca Giordano, and a library of 40,000 volumes, open to the public. But the crowning glory of Florence is its Grand Gallery, occupying the upper floor of the Ufizi, a building erected after a design of Vasari, by Cosmo I., consisting of two parallel corridors or galleries, each 448 feet in length, and 72 feet apart, united at one end by a third corridor. This contains some masterpieces of statuary, as the world-renowned 'Venus de Medici,' 'The Knife-Grinder,' the 'Fawn,' 'Niobe and Her Children,' etc. The collection of pictures comprises superb examples of all the best schools, and is said to surpass even that of the Vatican. A splendid apartment, known as the Tribuna, contains the rarest treasures of the collection, and is in itself a wonder of art, with its cupola inlaid with mother-of-pearl, and its rich marble pavement. Besides the Riccardi and Laurentian libraries, the Magliabecchi Library, containing a rare, extensive, and valuable collection of books, is also open to the public.

The literary and educational institutions of Florence are both numerous and important. At the head of these is the famous Academia della Crusca. The charitable institutions are numerous, extensive and well conducted. The common people of Florence are well clothed and have a comfortable appearance; and there are, as compared with most other Italian towns, few beggars, priests, and monks. The citizens are friendly, cheerful, and hospitable. The encouragement given under the government, to artistic and scientific studies, has conferred advantages on Florence unknown in most other parts of Italy. All sorts of foreign publications are met with here; and the facilities it affords for gratifying a taste for the fine arts, the beauty and security of the city and environs, and its salubrity and cheapness, make it, on the whole, a more desirable residence even than Rome. Manufactures silks, straw hats, articles of vertú, as intaglios, etc., jewelry, porcelain, perfumery, etc. Florence has produced more celebrated men than any other place in Italy, or, perhaps, of Europe; among others may be specified Dante, Petrarch, Boccaccio, Villani, Cosmo and Lorenzo de Medici; Galileo, Michelangelo, Leonardo da Vinci, Benvenuto Cellini, Alberti, Lapo Brunelleschi, Giotto, Andrea del Sarto, Machiavelli; Popes Leo X. and XI., and Clement VII., VIII., and XI.

Florence owes its origin to a colony of Roman soldiers sent thither by Octavianus after the victory of Perugia, to whom he allotted part of the territory of the colony of Fiesole, established about 40 years before by Sylla. Little more is known of it under the empire, and hardly any remains exist of that period, except some relics of an amphitheatre and a few inscriptions. Christianity was established here in the third century, and early in the fourth a Bishop of Florence attended a council at Rome. In the beginning of the 12th century the city had risen into importance through the industry and enterprise of its inhabitants, who had now commercial establishments in the Levant, France, and other parts, and had become money-changers, money-lenders, jewelers, and goldsmiths. In the latter end of the 14th century the wealthy family of the Albizzi became chief rulers in Florence. These again were overthrown in 1434 by Cosmo de Medici, a popular citizen and princely merchant, who assumed the first place in the state. On the fall of the republic in the 16th century a member of a lateral branch of the Medici, the line of Cosmo having become extinct, was placed by Charles V. as Duke of Florence. The ducal dynasty of Medici continued to rule till the year 1737, when, becoming extinct, they were succeeded by Francis of Lorraine, afterward emperor of Germany. From this period the history of Florence merges into that of Tuscany, until its amalgamation with the kingdom of Italy. From 1865 till 1871 it held the dignity of capital of the kingdom, the seat of government being transferred to it from Turin. It then received a considerable increase of population, and consequently a number of broad new streets have been constructed on the site of the old fortifications, and of late years its precincts have been extended in every direction. Pop. about 207,000.

Florence, S. C., a city and county-seat of Florence County, on the Atlantic C. L. R.R. It has a bank and several newspapers. Pop. (1910) 7,057.

Florentine Experiment, in physics, an experiment made in 1661 by some academicians at Florence to test whether or not water was compressible. They enclosed it in a globe of thin gold, afterward hermetically sealed. In compressing the globe the water, instead of yielding, forced its way through the pores of the gold, and stood in drops on its outer surface. See PHYSICS.

Florentine Fresco, a kind of painting, first practised at Florence during the flourishing period of Italian art, for decorating walls. Like common fresco, the lime is used wet, but in this mode it can be moistened, and kept damp and fit for painting upon. See FLORENCE; ITALY.

Florentine Lake, in painting, a pigment prepared from cochineal. It is now obsolete, the greater durability in oil-painting of the lake prepared from madder having entirely superseded those prepared from cochineal.

Florentine Mosaic, the term applied to the art of inlaying tables and other plane surfaces with *pietra dura* and *pietra commerse,* carried on principally at Florence. See ART; FLORENCE; ITALY.

Florentine School, an Italian school of painting during the 14th and 15th centuries remarkable for greatness; for attitudes seemingly in motion; for a certain dark severity; for an expression of strength by which grace is perhaps excluded; and for a character of design approaching to the gigantic. The Tuscan artists, satisfied with commanding the admiration, seem to have considered the art of pleasing as beneath their notice. This school has an indisputable title to the veneration of all the lovers of the arts, as the first in Italy which cultivated them. See ART.

Flores, Juan José, hoo-ān' hō-sā' flō'rāz, Venezuelan soldier and statesman: b. Porto Cabello, Venezuela, 1801; d. Guayaquil, Ecuador, 1 Oct. 1864. He distinguished himself as Bolivar's lieutenant in the war that secured the independence of South America. In 1823 he was governor of Pasto, and head of the army in Ecuador. His victory at Tarqui (1828) ended the war with Peru and he was made president of the republic of Ecuador (1831–5). He filled the same office in 1839 and from 1843 to 1845, when he resigned in consequence of a revolution stirred up by the liberals. He was defeated by Mosqueza in the war with Columbia at the battle of Cuaspuda, in 1863.

Flores, Venancio, vā-nān'thi-ō, South American soldier and statesman: d. Montevideo, Uruguay, 19 Feb. 1868. In 1853 he took part in an insurrection against Giro, the president of Uruguay and was elected president of the republic in January 1854. The two parties in the government were the Colored (Liberals), and the Whites (Conservatives), and the former being the stronger had elected Flores. A division in this party made it possible for a former president, Oribe, to land with troops, and Flores laid down his office, and in 1858 took refuge in Buenos Ayres. He returned later and with the help of Brazil stormed the city of La Florida in 1864 and in 1865 made a triumphant entry into Montevideo, and assumed the title of provisional governor of the republic. On 4 May 1865, he concluded a treaty of alliance with Brazil and the Argentine republic in the war against Paraguay. He won over the party of the Whites by his clemency, regained the presidency in 1866, but was assassinated on his way to the city hall, or capital of Montevideo.

Flores, flō'res. (1) *Endé* or *Mandfirei Floris,* a large island (Dutch) of the Indian Archipelago, forms one of the chain of islands which extend east from Java; length, about 200 miles; breadth, about 50 miles. It has a mountainous surface, with several volcanic peaks, one of which, Lobetobie, is 7,200 feet high. Little is known of the interior. Sandal-wood, once abundant, has become scarce. Endé, near the middle of the south coast, is said to be the principal port, and to have safe anchorage for any number of ships. The passage between the east end of the island and those of Solor and Adenara is called Flores Strait; and the part of the Pacific north of the Flores chain and south of Celebes is called the Flores Sea. (2) The most western island of the Azores, about 30 miles long by 9 miles broad, with a hilly surface, containing an extinct crater now converted into a lake. The chief products are wheat, pulse, and poultry, and great numbers of small cattle are reared. (3) An island of the North Pacific, off the west coast of British America, opposite to Vancouver's Island; lat. 49° 20′ north; lon. 125°

45′ west; length, northwest to southeast, 15 miles; breadth, from 2 miles to 6 miles. (4) A small island off the coast of Uruguay. (5) A river in Brazil in the province of Piauhy.

Florez, Henrique, en-rē'keth flō'reth, Spanish historian: b. Valladolid, Spain, 14 Feb. 1701; d. Madrid 20 Aug. 1773. He was an Augustinian ordinary who taught theology and history by presenting dogmas and annals from the standpoint of their human interest. ‘Sacred Spain’ (1747–73), and ‘Memorials of Catholic Queens’ are his most important works.

Florian, Jean Pierre Claris de, zhŏn pē-ār clä-rē dē flō-ryän, French poet: b. near Anduza, Gard, France, 6 March 1755; d. Sceaux, France, 13 Sept. 1794. He made his début with some pleasing farces (1779), and added greatly to his fame with the two pastoral stories, ‘Galatea’ (1783), and ‘Estelle’ (1787); sentimental romances in the dominant taste of that time. He also wrote: ‘Medleys of Poetry and Literature’; and ‘Florian's Youth,’ in which he recounts the story of his boyhood. In 1788 he became a member of the French Academy. While there, engaged in finishing his poem, ‘Ephraim,’ he was arrested by the orders of the Committee of Public Safety, but the fall of Robespierre saved him from the guillotine.

Floriculture in America.— Growing flowers as a business was unknown in America previous to about 1825; and, indeed as late as 50 years ago it was impossible to buy cut flowers in some of our leading cities. Owing to the increase of population of the eastern cities, and consequent increase of wealth and luxury, a demand for flowers began to be felt in the second quarter of the last century; and thus began the development of commercial floriculture in this country. This branch of horticulture first became prominent in the vicinity of Philadelphia and Boston. In the early days more wealth was centered in these cities, and the people there paid more attention to luxuries in home surroundings. New York was less prominent in the development of this industry. From 1830 to 1840 floriculture made considerable progress, owing to improved methods in the construction and management of greenhouses, as well as to the increased demand for flowers. The application of hot-water heat to greenhouses gave an impetus to the work, making it possible to grow better plants than had been done when heated air conducted through brick flues was the only means of keeping out the frost. Since the Civil War the development of the industry has been rapid and varied, as to extent and methods, and as to the kinds of flowers cultivated. Up to about 1885 the cultivation of plants was the leading feature of floricultural work; but since that time the rapid increase of wealth and luxury in the large cities has developed a tremendous demand for cut flowers, thus making this branch of the business the all-important one for the florist. This increased demand for cut flowers has led to specialization in floriculture and has produced the best work of the florist. Older flowers, such as the once popular camellia, have been dropped, and the rose, carnation, violet and chrysanthemum have been substituted. In this way floriculture, as we find it to-day, has been gradually evolved. There are two distinct departments of the word, viz., the growing of plants, and the cultivation of cut flowers. The plants grown mostly are various kinds of palms, ferns, rubber plants and dracænas; also ornamental and bedding stock for out-door purposes. There has been specialization in both of these main branches of floriculture. For instance, certain growers devote all their energies to palms; others concentrate on ferns; others raise bedding-plants exclusively. In flower-growing there has been even greater specialization; and it would now be difficult to find an important establishment where more than one of the leading flowers is grown. While one florist will grow roses exclusively, another will devote all his time and ingenuity to the improvement of the carnation, a third will grow nothing but violets, and a fourth will concentrate on chrysanthemums. These four flowers are the most important cut flowers, their commercial importance being in the order named. The most recent statistics on floriculture in the United States are to be found in the United States Census of 1900. At that time there were 8,799 floricultural establishments, representing an investment (land, equipment, etc.), of $52,462,419, and selling flowers and plants to the amount of $18,759,464 annually. About two-thirds of this amount was realized from cut flowers, the rose bringing in $6,000,000, the carnation $4,000,000, the violet $750,000, the chrysanthemum only $500,000, owing to the shortness of the season. The annual expenditure for labor was $4,155,179, or 22.6 per cent. of the total receipts. Since the figures given above are something less than the wholesale price, and the profit of the retailer is about 100 per cent., it is clear that the public spends annually some $30,000,000 on flowers.

There are few adequate treatments of floriculture. As among the best may be mentioned: Henderson, ‘Practical Floriculture’; Hunt, ‘How to Grow Cut Flowers’; Taft, ‘Greenhouse Management.’ Consult also Bailey's ‘Garden-Craft’ series, and his ‘Cyclopedia of American Horticulture.’ See BOTANY; BREEDING PLANT; HORTICULTURE; FLOWER; FLOWER AND INSECTS; GARDEN; INFLORESCENCE; GREENHOUSE; CROSS-FERTILIZATION; FERTILIZATION, ETC.

Florida (Sp. flowery, a name given to the country by Ponce de Leon because he discovered it on Easter Day, Sp. *Pascua florida* or *de flores*, flowery Easter; or, according to some authorities, on account of the exuberance of flowers which he saw), the southeasternmost State of the Union, sometimes called "the Everglade State," and also "the Peninsular State." It is situated between lat. 24° 30′ and 31° N. and lon. 79° 48′ and 87° 38′ W. Alabama and Georgia bound it on the north, the Atlantic Ocean on the east. On the South, Florida Strait, which connects the Gulf of Mexico with the Atlantic, separates the peninsula from Cuba, and the Bahamas. West of the peninsula and south of the western extension of the State is the Gulf of Mexico. The extreme western boundary is the Perdido River in Alabama.

Florida is mainly a peninsula of irregularly rectangular form. The northern part is continental, and extends about 400 miles from east to west. From north to south the peninsula extension is about 375 miles in length, and nearly 100 miles in width, the total length of the State north and south being about 450 miles. From Biscayne Bay, near its southeastern extremity, stretches a series of islets or keys, the only one of importance being Key West, situated at the lower end of the chain.

The physical features of the State are decidedly dissimilar to those of the other Southern States. The geological upheaval resulting in its formation left neither table-land nor mountain from which to view ocean and gulf, the most elevated portion of the State barely reaching the dignity of a hill-country. Its area is 58,680 square miles, 4,440 being lakes, lagoons, and rivers. Its coast-line, excluding islands, is 1,145 miles, 470 miles of it being in the Atlantic Ocean. Capital, Tallahassee.

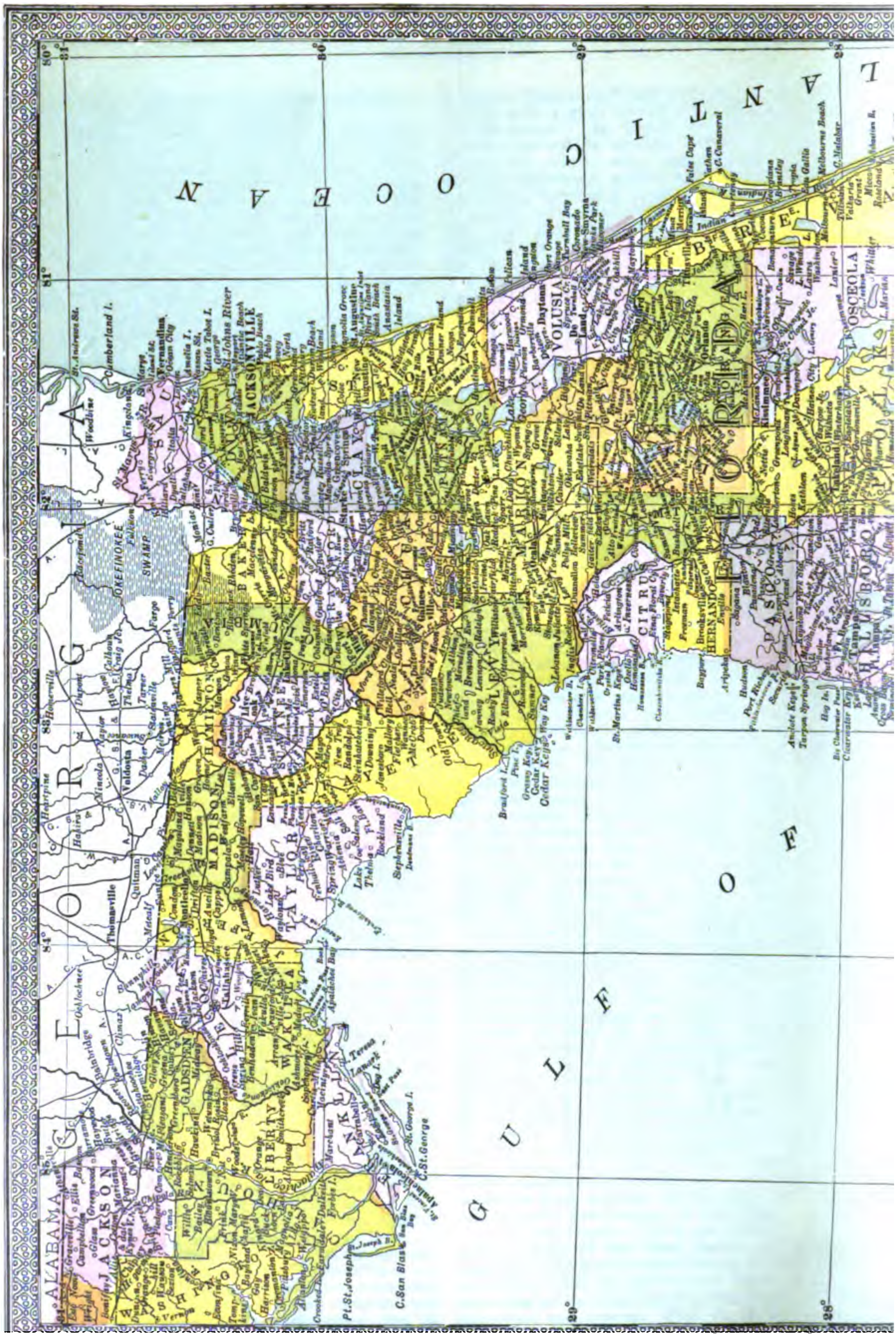
Surface, Soil and Drainage.— The northwestern part, continuing the Alabama uplands, is a hilly rolling country sinking to a flat strip of coast. The east is part of the Atlantic coastal plain. The peninsula is a surface of sand and marsh, lying in the north on a basis of Upper Eocene or Vicksburg limestone; in the south on one of coral whose southern extremity is the bounding wall of the Gulf Stream, silted up at the end into the «keys.» These have spread by deposits and vegetable growth into habitable islands, and in the course of ages will be joined to the peninsula, which itself is yet but land in the making. Almost everywhere the water lies close below the surface, which is dotted with springs, some of which are charged with carbonates and sulphuretted hydrogen; many fresh and of immense size, and of crystal clearness. One of the most famous is near St. Augustine, two miles out at sea, and boils so violently that the waves break against it as against a sunken reef. Another large one is in St. George's Sound, opposite Lanark. The wonderful Silver Spring, at the head of navigation on the Ocklawaha River, near Ocala, Marion County, has an estimated outflow of 300,000,000 gallons daily. The Blue, in the same county, the Wekiva in Orange County, and the Wakulla near Tallahassee, are also famous.

As the soil is a mere surface deposit with no volcanic upheaval, the State has no real hills; but the centre has a watershed in the shape of a ridge from 100 to 300 feet high, with a summit level 200 miles north of the strait, from which low sand-terraces decline each way to the sea, with countless lakes and swamps at their bases. Many of the lakes are aggregates of the great springs before mentioned. The largest is Okeechobee in the south, 1,200 square miles in area and 25 feet above the sea-level, its waters sinking into the Everglades; a bordering rim of sand about 25 miles wide divides it from the Atlantic. Others are Monroe, Georgia, Kissimmee, Crescent, Dexter, Apopka, Harris, Orange, and Eustis. Most of them are shallow and usually connected by fresh-water streams. On the higher levels the terraces are covered with a magnificent growth of large pine-trees; on the lower levels are prairies and marshes timbered with cypress-trees, and in which are «hummocks,» which are dry elevations, covered with a great variety of hardwood, and cabbage-palms. The basins of the draining streams are mostly marshy jungles of cane-brake and vines and semi-tropical trees. In the southernmost portion are the remarkable Everglades, forming a district 160 by 60 miles in extent, and containing 3,600 square miles, both land and water; and overflowed marsh hidden by tall grass, and thickly dotted with dry «hummocks» ranging in size from those just large enough to stand on, up to those covering a square mile or more, and covered by a jungle of vines and shrubs, pine, and palmetto. The eastern part is a maze of these islands and small shallow bayous. The islands were once really such in the ocean, the water around them having silted up and been overgrown with vegetation. The Everglades are separated from the Gulf by extensive cypress swamps; the forests extend down the west coast, narrowing out around the cape, and stretch up along the Atlantic coast. The latter, except in the extreme north, is almost harborless, a line of narrow sand-spits with interior lagoons, the type of the whole southern coast; but the gulf side, otherwise formed in the same fashion, is pierced with many deep bays and harbors — Pensacola, Santa Rosa, St. Andrew's, St. George's, Appalachee, Tampa, Hillsboro, Charlotte Harbor, Oyster, Ponce de Leon, Cedar Keys, etc.

The great river of Florida is the St. John's, rising in Cypress Swamps, just north of the Everglades, and flowing north parallel with the ocean, threaded on a series of lakes; 150 miles from its mouth becoming a mile wide, and in its lower course six or seven, a miniature Amazon in size and character and draining a similar country. Pleasure-steamers navigate it 250 miles, and the tributary swamp-rivers several hundred more. Its total course is 350. The Kissimmee, flowing into Lake Okeechobee from Kissimmee Lake, is also a favorite of tourists and sportsmen. The leading streams of the west are the Suwanee; the great Appalachicola from Georgia, 90 miles long under that name, with a course of nearly 600 through the Chattahoochee; the Choctawhatchee (180 miles), and Escambia (250 with the Conecuh) from Alabama, the latter navigable to the Conecuh.

Climate.— The climate of Florida is not subject to prolonged and severe winters with great ranges in temperatures. The annual precipitation is from 58 to 60 inches, ranging from 6 to 8 inches in the fall and winter — the dry season — to 18 to 20 inches during the summer. The normal sunshine is about 60 per cent. The normal mean temperature for January ranges from 60° to 70° F., that for July being 80° and above. The hottest months are June, July, and August, the heat being tempered by frequent showers. Already famed as the Riviera of America, offering hope to the invalid and pleasure and comfort to the robust, Florida occupies a unique place among the States of the Union. The large immigration of a rich and cultured class has had a great influence on the social, political, and business development of the State.

Flora and Fauna.— These are naturally affiliated to those of the West Indies and South America. The forests are estimated at 25,000,000 acres, two thirds the area of the State; largely consisting of live-oak, hickory, long-leaved pine, pitch-pine, and cypress. Prof. A. H. Curtis, a


GEORGIA
ALABAMA
OKEFINOKEE SWAMP
OCEAN
ATLANT
GULF OF
FLORIDA
JACKSON
WASHINGTON
CALHOUN
LIBERTY
GADSDEN
LEON
WAKULLA
FRANKLIN
TAYLOR
MADISON
HAMILTON
COLUMBIA
BAKER
NASSAU
DUVAL
JACKSONVILLE
CLAY
BRADFORD
ALACHUA
LEVY
MARION
PUTNAM
ST. JOHNS
VOLUSIA
ORANGE
CITRUS
HERNANDO
PASCO
HILLSBORO
POLK
OSCEOLA
BREVARD
Thomasville
Valdosta
Quitman
Fernandina
St. Augustine
Daytona
C. Canaveral
C. San Blas
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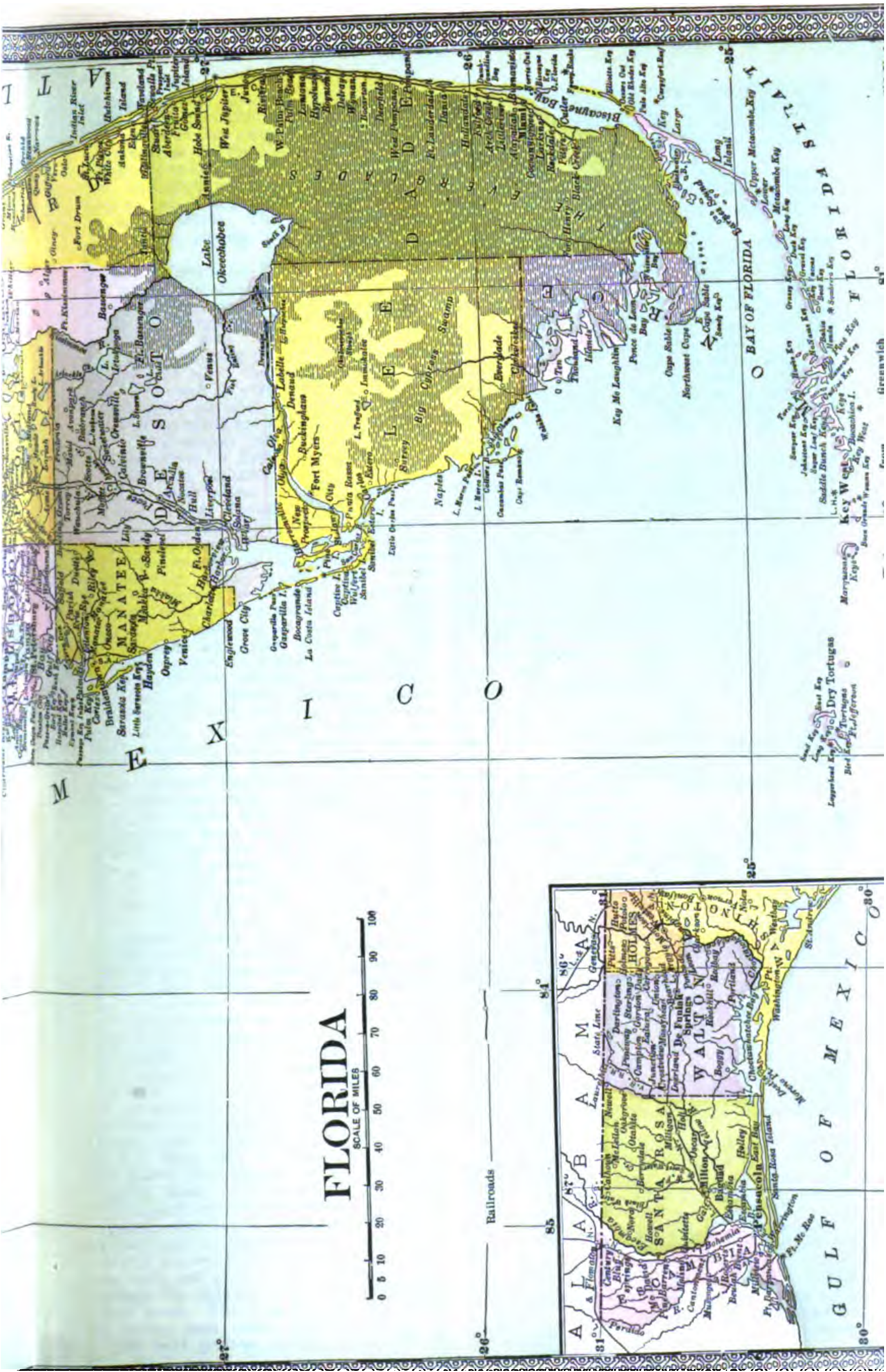
FLORIDA
SCALE OF MILES
0 5 10 20 30 40 50 60 70 80 90 100
Railroads
MEXICO
GULF OF MEXICO
FLORIDA STRAITS
BAY OF FLORIDA
Lake Okeechobee
EVERGLADES
DADE
LEE
DE SOTO
MANATEE
MONROE
Big Cypress Swamp
Fort Myers
Key West
Dry Tortugas
Cape Sable
Biscayne Bay
Miami
Palm Beach
Punta Gorda
Charlotte Harbor
Sarasota
Bradentown
Naples
Long Island
Greenwich
ALABAMA
SANTA ROSA
WALTON
HOLMES
ESCAMBIA
WASHINGTON
Pensacola
Milton
Santa Rosa Island
Choctawhatchee Bay
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distinguished botanist, says that Florida has a greater variety of trees than any other State in the Union. Florida has many trees peculiar to itself, or almost so, in the United States — the wild orange, cocoanut, and Indian almond, mahogany, satinwood, and manchineel, cachibou and kino-gum, etc. The tropical fruit acclimated there is noted below. The alligator, green turtle, and sponge, indicate the tropic nature of the State.

Fish and Fisheries.— Florida's enormous coast-line in the mid-continental seas gives its fisheries the greatest extent and value of any State south of Virginia; they employ seven or eight thousand men. Foremost is that of the red snapper, utilizing some 200 vessels besides hundreds of boats, the headquarters being Pensacola; the catch is over $2,000,000 a year, mostly packed in ice and sent North. Shad, mullet, and green turtle are also caught in large quantities. The sponge fishery is peculiar to Florida, and centres in Key West; it has produced as much as $250,000 a year. Alligators are caught for their skins.

Agriculture and Forest Products.— The rich phosphatic soil mingled with decaying vegetation, the large rainfall, and warm climate render Florida enormously fertile, and dictate its representative crops. It of course raises corn and other cereals for its own use—in 1910 it produced 8,814,000 bushels of corn from 678,000 acres of land—and at last report had over 500,000 neat and 95,000 dairy cows; but its chief export crops are semi-tropical. Sugarcane, Sea Island cotton, and rice; 190,000 bushels a year of the last named; potatoes, 475,000 bushels, valued at $570,000, from 5,000 acres, in 1909; peanuts, over 1,000,000 bushels; cassava, nearly 10,000,000 pounds; tobacco, 2,380,000 pounds in 1910; with some 7,000,000 watermelons and 3,500,000 muskmelons a year, besides general market-gardening products for the North, are the typical field crops of the State. Several thousand acres are devoted to watermelons for the seed alone, for which there is an extensive northern market. The orchard crops are rich in tropical products — lemons (2,357 boxes in the census year), limes (22,714 boxes), grape-fruit (2,306 boxes), guavas (1,645,000 fruit), Japanese plums (75,110 fruit), olives, figs (66,680 pounds), cocoanuts (136,600 nuts), etc.; but the two leading crops are oranges and pineapples. The former has been subject to immense vicissitudes. Early in the nineties it was the one speculation of central Florida, and the product rose to 5,000,000 boxes in one year; then the terrible cold wave of 1894–5 froze millions of young trees to the roots, often splitting them in two. The older trees, where well handled, generally survived, but another cold wave in 1899 — giving native Floridans the unprecedented sight of several inches of snow — destroyed a large part of those also; the two disasters killed three fourths of all the orange trees in the State. The crop sank to 125,000 boxes or so, and most of the growers abandoned the business, thinking a permanent change of climate had set in; but it is now known that these frosts occurred now and then in earlier times as well, and growers are recovering courage, though the industry is shifting toward the southwest coast. The crop for 1902 was about 750,000 boxes, over treble that for the census year. The next greatest orchard crop — though peaches and pears are considerably grown — is the pineapple, raised mainly in the southeastern counties. Florida in the census year produced nearly 3,000,000 of the fruit, against 440 from California and none from any other State.

In 1902 the Florida East Coast & Drainage Sugar Company was formed to drain the Everglades, which will reclaim some millions of acres of valuable agricultural land.

The forest products are usually ranked under manufactures. The lumber and timber product of Florida, with the tar, turpentine, and ship stores, amount to about $15,000,000 yearly, or nearly as much as all the rest of the State's manufactures together. The turpentine and rosin—236,778 barrels of the former, 772,537 of the latter—were valued at $6,469,605, and the industry employed 15,073 hands, or toward half the industrial workers of the State. The industry has grown from almost nothing within 20 years, there being in 1890 only 484 hands and $191,859 product.

Minerals.— Florida has no metals, and its mineral industries are of rock and earths. The chief is the mining of phosphate rock for fertilizers (q.v.), in which it rivals any other district of the world. It is in various forms — hard and soft rock, land and river pebble, and vertebrate remains. The hard rock — much the most valuable, containing 80 per cent phosphate of lime — is found in a belt skirting the Gulf from Tallahassee nearly to Tampa. It was discovered in 1888, and since then the product has risen to some 750,000 tons a year of all kinds — 500,000 being hard rock, nearly all exported to Europe, principally Germany. The river pebble is only worked on the Peace and Alafia rivers, by dredges and pumps. Most of the fuller's earth used in the United States is also from Florida. At Ellenton, on the Manatee River, 60,000 tons has been produced in a year, and at Quincy 30,000 tons. Some $40,000 a year of kaolin also goes out.

Manufactures.— The greatest industry of Florida, aside from the forest products, is the tobacco and cigar manufacture, of which the heart is Tampa and Key West; it was developed by the immigration of Cuban cigarmakers, and still uses mainly Havana leaf. Some 300,000,000 cigars a year are turned out, and the total value of tobacco products manufactured in the census year was $10,891,286; the industry employed 6,461 wage-earners. The fertilizer industry from phosphate rock amounts to over $500,000 a year, against less than $100,000 in 1890, and nothing two years before. Wooden boxes and barrels, cedar for lead-pencils, sugarcane syrup, cotton-seed oil, and meal are also to some extent exported, though the consumption is largely at home. Jacksonville has two establishments for canning pineapples, guavas, etc.

Commerce and Transportation.— Florida's position makes it the natural outlet for exports to the West Indies; but till late years unimproved harbors and inferior railroad equipment have checked its commerce. Within the past 15 years, however, Congress has expended over $6,000,000 on its river and harbor improvements (appropriating nearly $3,000,000 more in 1902); and its railroad lines have more than trebled in mileage, and increased in even greater ratio in quality of service. The mainland harbors on its immense peninsular coast-line, with its noble island port Key West, do an export trade of toward $20,000,000 a year, with some $2,000,000 of imports. About 3,000 vessels a year, of over 2,500,000 gross tons, clear from Florida ports. The chief exports are timber and lumber (over $7,500,000 a year), naval stores, fruits, corn, cotton, tobacco and cigars, phosphate rock and fertilizer, fish, and horses, mules, and cattle to Cuba. The largest exporting places are Pensacola, Tampa, Jacksonville, and Key West. There are important steamer lines running from Jacksonville to Charleston, New York and Boston; from Tampa to Havana and Porto Rico (great sums having been recently expended on its terminal facilities); from Key West to Havana, Galveston, New Orleans, and New York; and from Miami to Nassau and Cuba; also coasting lines from Fernandina, Apalachicola, Carrabelle, and Punta Gorda. There is much tourist and business navigation on its fine rivers and bays. The railroad mileage is now some 3,500, of which 2,800 is main track; there are several through express trains to and from the North daily, and three great trunk lines traverse the peninsula — the Atlantic Coast Line, Seaboard Air Line, and Florida East Coast.

Banks.—On 1 Sept. 1910 there were 43 national banks in the State, with capital paid in of $5,750,800; the amount of deposits in savings banks (1910) was $1,294,086.76, from about 8,000 depositors, averaging $160 each. No State banks or loan and trust companies reported that year.

Finance.—The assessed valuation of the State is slightly over $136,000,000, which is 50 per cent of the actual value; the tax rate is $7.50 for 1910. The bonded debt for the fiscal year 1908 was $601,567. The county taxes produce over $1,250,000 a year, the school districts over $70,000.

Education.—The State maintains about 2,400 public schools, with about 2,700 teachers, of whom about 1,700 are women. The average monthly salary is $44.49 for white males and $35.44 for white females. Total paid for salaries, $569,733.33; annual expenditure on schools, $775,000, or about $1.35 per capita; about half the average for the Union, and one of the lowest averages among the States. The average attendance for the year was 55 days for white children, 41 for colored. The illiterates above 10 number over one fifth of the population. This is misleading, however, unless classed by color: the illiterate whites numbered 19,184 out of 297,812, or 6.4 per cent, while the illiterate colored numbered 65,101 out of 230,730, or over 35 per cent. The educational status is gradually improving. There are some 30 high schools in the State. The Constitution provides for two normal schools, a white and a colored; the former is at De Funiak Springs, the latter at Tallahassee. There are also three private normal schools. For colored secondary education there are three institutions at Jacksonville and one at Live Oak. For whites there are, besides the State Agricultural College at Lake City, seminaries for East Florida at Gainesville, West Florida at Tallahassee, South Florida at Bartow. There are also several private and denominational colleges, including the John B. Stetson University at Deland, affiliated with the University of Chicago, and Rollins College at Winter Park.

Charitable and Penal Institutions.— There is a State hospital for the insane at Tallahassee accommodating about 1,000 patients, and treating some 300 new ones a year; a school for the blind and for deaf-mutes at St. Augustine; and a State reform school. The State penitentiary contains something over 1,000 inmates; out of 500 the colored prisoners number about one half. The State farms out its convicts for mining phosphate, etc.

Religious Denominations.— The strongest in the State are the African Methodist Episcopal, the Methodist Episcopal South, the Regular Baptist South, the Regular Baptist Colored, Roman Catholic, Methodist Episcopal, Protestant Episcopal, Presbyterian, Disciples, and Congregational.

State Government.—The Constitution is of November 1886, and made sweeping changes from the former one in the direction of democracy. The State and county officers had formerly been mostly appointed by the governor, and the Supreme Court justices were appointed for life; under the present Constitution all are elected, except circuit judges, and the judges' terms are six years. The governor is elected for four years, and cannot be re-elected for an immediately succeeding term. His salary is $3,500. His veto may be overridden by a two thirds vote of the members present in both Houses. In case of vacancy, the succession devolves on the president of the Senate and the speaker of the House successively. The legislature consists of 32 senators and 68 representatives, and meets biennially, with sessions limited to 60 days except at their own expense. There is a railroad commission to enforce reasonable rates of freight and passenger carriage. The divorce law requires two years' residence. Counties have local option at the request of one fourth of the registered voters. There are 1,258 militia. The State has two representatives in Congress. It is overwhelmingly Democratic in politics; in the legislature of 1903 there were 67 Democratic representatives and one Republican.

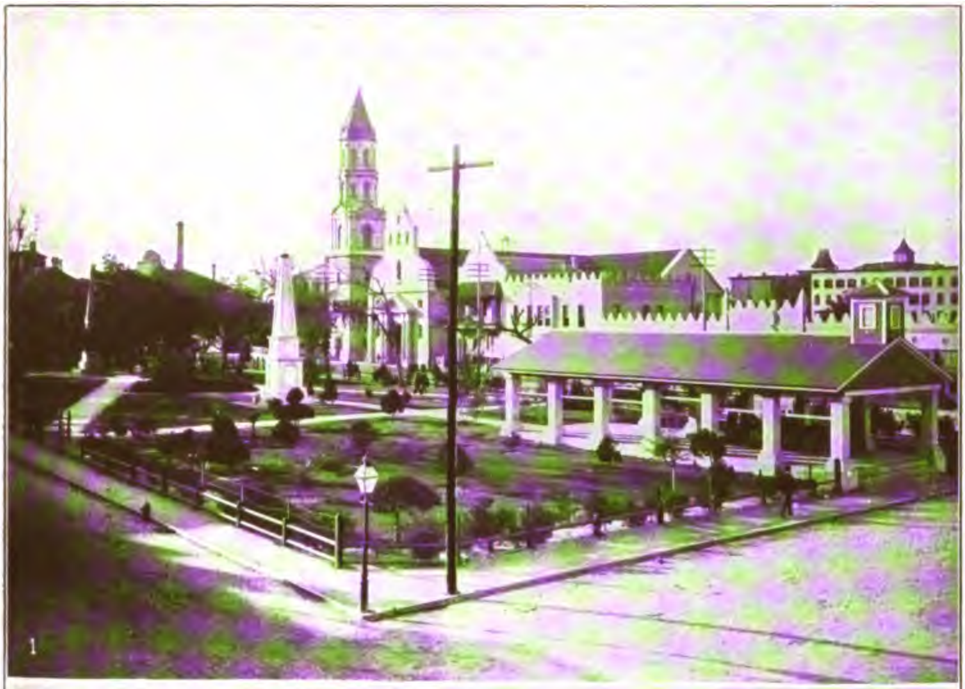
Population.—1830, 34,730; 1840, 54,477; 1850, 87,445; 1860, 140,424; 1870, 187,748; 1880, 269,493; 1890, 391,422; 1900, 528,542. The foreign-born numbered 23,832, mostly West Indians. The colored population was 230,730, or a little over two fifths. The last census (1910) showed a population of 751,139, an increase of 42.1 per cent.

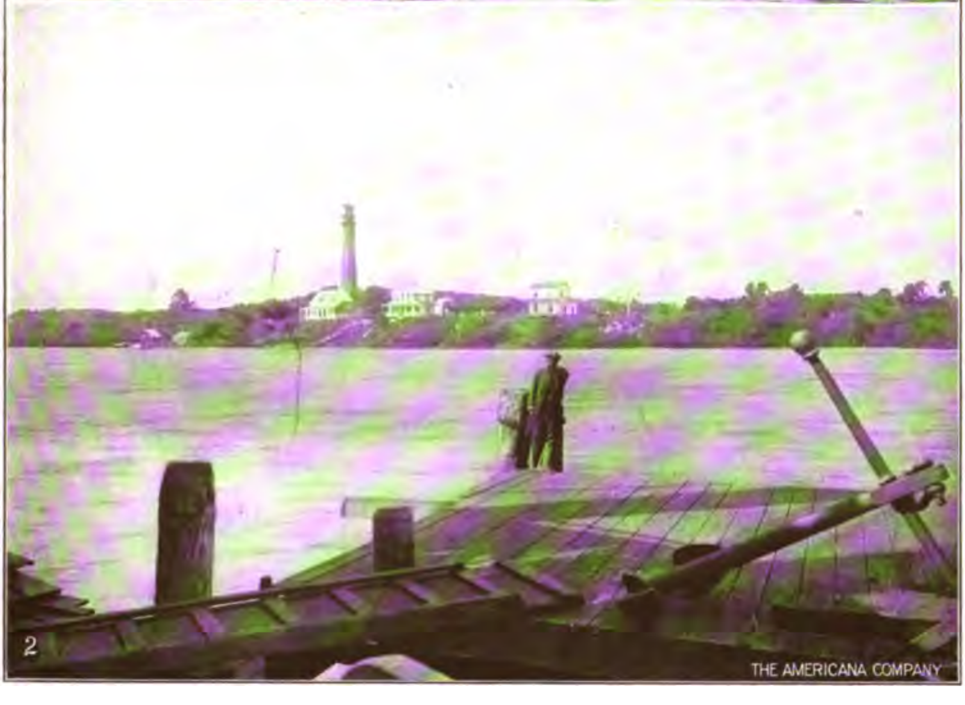
The State has 47 counties, which, with their capitals, are as follows:

Alachua, Gainesville.
Baker, MacClenny.
Bradford, Starke.
Brevard, Titusville.
Calhoun, Blountstown.
Citrus, Inverness.
Clay, Greencove Springs.
Columbia, Lake City.
Dade, Miami.
De Soto, Arcadia.
Duval, Jacksonville.
Escambia, Pensacola.
Franklin, Apalachicola.
Gadsden, Quincy.
Hamilton, Jasper.
Hernando, Brooksville.
Hillsboro, Tampa.
Holmes, Westville.
Jackson, Marianna.
Jefferson, Monticello.
Lafayette, Mayo.
Lake, Tavares.
Lee, Myers.
Leon, Tallahassee.
Levy, Bronson.
Liberty, Bristol.
Madison, Madison.
Manatee, Braidentown.
Marion, Ocala.
Monroe, Key West.
Nassau, Fernandina.
Orange, Orlando.
Osceola, Kissimmee.
Palm Beach, W. Palm Bch.
Pasco, Dade City.
Polk, Bartow.
Putnam, Palatka.
St. John St. Augustine.
St. Lucie, Fort Pierce.
Santa Rosa, Milton.
Sumter, Sumterville.
Suwanee, Live Oak.
Taylor, Perry.
Volusia, Deland.
Wakulla, Crawfordville.
Walton, DeFuniak Springs.
Washington, Vernon.

The chief cities are Jacksonville, on the St. John's, with a population of 57,699, in 1910, in-

SCENES IN FLORIDA.





1. The Plaza, St. Augustine.

2. Jupiter Light.

creased from about 40,000 in 1903; Pensacola, 22,982; Key West, 19,945; Tampa, 37,782; West Tampa, 8,258; Gainesville, 6,183. No other place has as much as 6,000 people, and only four over 5,000 — St. Augustine, 5,494; Lake City, 5,032 and Tallahassee, the State capital, 5,018 and Miami, 5,741. Between 3,000 and 5,000 are Ocala, Palatka and Fernandina, Daytona, Lakeland, Live Oak, Orlando, Quincy, St. Petersburg, Sanford, and Apalachicola.

History.— The earliest attempted colonization of the North American mainland was in Florida, and the first white settlement was St. Augustine. Juan Ponce de Leon discovered the coast a little north of St. Augustine 27 March 1512; was made governor, and authorized to colonize the "Island of Florida," as it was then supposed to be, in 1513; and sought there for the "Fountain of Youth." Thenceforward it was the highway of Spanish explorers. Vasquez de Ayllon raided it for slaves 1520-6, Pánfilo de Narvaez began his fatal expedition westward in 1528 from Pensacola Bay; Hernando de Soto his in 1539 from Tampa Bay; Tristan de Luna in 1559 explored northward from Pensacola Bay. Coligny designing to found a Huguenot colony and refuge in the New World, René de Laudonnière in 1564 built Fort Caroline on the St. John's; in 1565 Pedro Menendez de Avilèz captured the fort, massacred the French there and in two detachments outside, "not as Frenchmen but as heretics," and built St. Augustine; in 1567 Dominique de Gourgues in turn exterminated the Spaniards at the settlement that had replaced Fort Caroline, "not as Spaniards but as assassins." St. Augustine was overlooked; but in 1586 Sir Francis Drake destroyed it. All through the 17th and early 18th centuries the Spaniards in Florida harassed, or set on the Indians to harass, the English colonies, from St. Augustine as headquarters, especially after Georgia was settled; and St. Augustine was repeatedly attacked by colonial expeditions. The Spaniards did but little toward settling the country, however. In 1763 East and West Florida — the latter west of the Apalachicola, and including parts of modern Alabama and Mississippi — were ceded to Great Britain, and in the next 20 years more than 25,000 whites had settled there. In 1783 it was retroceded to Spain, and most of the English settlers withdrew. In 1795 West Florida was sold to France. After the Louisiana Purchase of 1803 the United States claimed up to the Perdido as part of "Louisiana"; the claim was not then pressed, for fear of war; but in 1810, the Spanish monarchy being overthrown and the king a prisoner, the United States took possession of all but Mobile, which was occupied in 1813 during the War of 1812. Meantime and afterward, the Southern States found East Florida an intolerable thorn in their flesh. The so-called Spanish "government" there was mere anarchy, partly from there being no stable home government to control it; Indian bands raided Georgia and escaped over the border, British and Spanish traders intrigued with them, and it was an Alsatia for fugitive slaves which drove the slaveholders wild. Congress authorized Madison to take "temporary possession" in 1811, but nothing was done; in 1818 Jackson invaded it to punish Spanish assistance to the Seminole raids and withholding fugitive slaves, captured St. Mark's and Pensacola, and hanged Arbuthnot and Ambrister, two British adventurers making their account by furnishing supplies and possibly other help to the Indians. The district being both profitless and untenable to Spain, she ceded it to the United States by treaty of 22 Feb. 1819, in exchange for government assumption of $5,000,000 claims of American citizens against Spain. The latter only ratified it in 1821 (see ANNEXATION). In March 1822 it was admitted as a Territory. The two sections, East and West Florida, both from geographical and political reasons, had no sympathy with each other, and repeatedly petitioned Congress for separation, without avail. Especially West Florida, as late as 1869, voted for annexation to Alabama, which offered the State $1,000,000 for it; but no further steps were taken. On 11 Jan. 1839 a convention framed a constitution for the State of Florida; but it was not admitted to the Union till 3 March 1845, paired with Iowa, as a slave State with a free State. The Constitution, forbidding emancipation of slaves by the legislature, roused a violent debate in Congress over admission. From 1835 to 1842 raged the bloody Seminole war (q.v.), ending in the deportation of the tribe to Indian Territory in 1843. On 10 Jan. 1861 an ordinance of secession was passed, 62 to 7; and on 4 Feb. the Florida delegates took their seats in the Confederate Congress. The government posts nearly all fell into Confederate hands; but Fort Pickens, off Pensacola, was retained, and formed a nucleus for recapture. After 1863, however, the Union forces were employed in other quarters; and by the battle of Olustee, 20 Feb. 1864, the State was lost to the Union till the close of the War restored it. On 13 July 1865 a provisional government was formed; on 25 October a State convention met, and on the 28th annulled the ordinance of secession. A new constitution was adopted without slavery, and a legislature organized in 1866; but on 2 March 1867 it was brought under the Reconstruction Act, and became a part of the Third Military District. A constitution of 25 Feb. 1868 chose officers to hold till January 1873, and by act of 25 June 1868 Florida reorganized as a State. Reconstruction conditions here were as anarchic and deplorable as elsewhere (see ELECTORAL COMMISSION; RECONSTRUCTION); but in the last 20 years the enormous investments of Northern capital in industries and railroads, the national expenditures on harbors, etc., have made it a strong and thriving State. Consult: Norton, 'Handbook of Florida' (1892); Fairbanks, 'History of Florida' (1871); Barbour, 'Florida' (1884).

CHAS. H. SMITH,
Secretary Board of Trade, Jacksonville.

Florida Agricultural College, an important educational institution at Lake City, Florida, established in 1884. It is under the direct control of a State board appointed by the governor. There are 200 students of both sexes.

Florida Blanca, José Moñino, hō-sā' mōn-yē'nō flō-rē'thä blän'kä, COUNT OF, Spanish statesman: b. Hellin, Murcia, 21 Oct. 1728; d. Seville 20 Nov. 1808. He was Spanish ambassador at Rome during the pontificate of Clement XIV., and particularly distinguished himself by his activity in the abolition of the order of the Jesuits, and in the election of Pius VI. In 1777 he became minister of foreign affairs, and at once acquired almost unlimited authority in Spain. He introduced post-coaches, and caused the post-roads to be made practicable; directed his attention to the most important subjects of general police, particularly in the capital; embellished Madrid, and was on every occasion the active friend of the arts and sciences. His attack upon Algiers in 1777, and the siege of Gibraltar in 1782–3, were unsuccessful; but the result of his co-operation with the English colonies of North America in securing their independence was more favorable to Spain. After the accession of Charles IV., his enemies succeeded, in 1792, in effecting his disgrace. He was imprisoned in the citadel of Pampeluna, but was soon restored to liberty and banished to his estates. He appeared once more upon the political stage in 1808, when he was president of the extraordinary Cortes.

Florida Cape. See Cape Florida.

Florida, Gulf of. See Florida Straits.

Florida Jay. See Jay.

Florida Keys, or **Reefs,** in Florida, a chain of small islands, keys or reefs, and sandbanks, extending southwest from Cape Florida, about 220 miles. They are very considerable in number, but only a few are of any importance. Among these may be mentioned Cayo Largo, Indian Key, Long Island, Old and New Matacombs, Cayo de Boca, and Key West, on which the city of Key West is built.

Florida Straits, or **New Bahama Channel.** The gulf waters separating Florida from Cuba and the Bahamas, and traversed by the Gulf Stream. The total length is 300 miles, with a width of from 50 to 150 miles.

Florida, Treaty of. In American history, a treaty signed between Spain and the United States, 22 Feb. 1819, by which Spain conceded the Floridas to the United States. Until the final ratification of the treaty Congress had passed a law empowering the President to appoint a governor, and Gen. Andrew Jackson assumed command of the Florida region. Gen. Jackson issued a proclamation at Pensacola requiring obedience to United States authority. See Florida; United States — Arbitration in the.

Florin, the name of a coin first struck in Florence in the 13th century. The silver florins of Holland are worth about 40 cents. The British and Austrian florins are each worth 50 cents. The English florin was first coined in 1849. See Numismatics.

Florio, Caryl. See Robjohn, W. J.

Florio, John, English lexicographer and translator: b. London of Italian parents about 1553; d. 1625. He taught French and Italian in Oxford University, and was appointed by James I. teacher of languages to the queen and Prince Henry. His chief works are his great Italian and English dictionary, 'A World of Words' (1598, improved edition 1611), and his translation of 'Montaigne' (1603).

Floris, flō'ris, **Frans** (originally **de Vriendt**), Flemish painter: b. Antwerp 1517; d. there 1 Oct. 1570. He was called by his contemporaries the Raphael of Flanders. He went to Italy, where his taste, particularly in design, was improved by the study of the masterpieces of Michelangelo; but he never equaled the grace and purity of form which distinguished the Florentine and Roman masters. His style was grand; but his coloring and his figures are reproached with dryness and stiffness. Most of his works, and in particular his triumphal arches, made on the occasion of the entry of Charles V. and Philip II. into Antwerp, and his 'Twelve Labors of Hercules,' have often been engraved by skilful artists. His paintings are to be met with in Flanders, Holland, Spain, Paris, Vienna, and Dresden.

Flor'izel, in Shakespeare's 'Winter's Tale'; the Prince of Bohemia, hero of the drama, and the lover of Perdita.

Flo'rus, Roman historian, of the 2d century A.D., probably a native of Spain or Gaul. He is variously styled in the manuscripts; in some L. Annæus Florus, in others L. Julius Florus, in others L. Annæus Seneca, and in one simply L. Annæus. He wrote an abridgment (epitome) of Roman history in four books, from the foundation of the city to the first time of closing the Temple of Janus, in the reign of Augustus. His style is florid, and not sufficiently simple for history. The best edition is that of Duker (Leyden 1744); later ones are by Titze (1819) and Seebode (1821).

Floss Silk, the portions of raveled silk broken off in reeling the silk from the cocoons, carded and spun into a soft coarse yarn, and used for common fabrics. See Silk.

Flotow, Friedrich (frēd'rĭн flō'tō) **von,** German musical composer, b. Teutendorf, Mecklenburg-Schwerin, 27 April 1812; d. Wiesbaden 24 Jan. 1883. His earlier operas (which include one called 'Rob Roy') did not find favor among the Parisian opera-house directors, so he had to content himself with performances in the private theatres of the aristocracy. This brought him gradually into notice, however, and his 'Naufrage de la Méduse' was publicly produced in 1839. 'Alessandro Stradello' was first performed at Hamburg in 1844, and his most successful opera, 'Martha,' was originally given at Vienna in 1847. His subsequent works, such as 'Indra' (1852), 'Rübezahl' (1854), 'Albin' (1856), 'L'Ombre' (1869), achieved but small success.

Flotsam, Jetsam, and **Ligan,** in law, flotsam, or floatsam, is derelict or shipwrecked goods floating on the sea; jetsam, goods thrown overboard which sink and remain under water; and ligan, goods sunk with a wreck or attached to a buoy, as a mark of ownership. When found such goods may be returned to the owner if he appear; if not, in England, they are the property of the crown. See Derelict; Salvage.

Flounder, any of several of the more common and useful flat fishes (q.v.) of northern waters. The commonest American species are the «summer» and «winter» flounders. The latter (*Pseudopleuronectes americanus*) is dark rusty brown, more or less spotted, about 15 inches long when large, and weighs one to two pounds. It is caught in the colder months from Chesapeake Bay to Labrador, and is excellent eating. The «summer» flounder (*Paralichthys dentatus*) becomes twice as large, is light olive brown, studded, when adult, with numerous small white spots, and is excellent eating. The «four-spotted» flounder (*P. oblongus*), and the

Gulf species (*P. albiguttus*), are closely related. On the Pacific coast several good species are known; and the British coast has a valuable species in *Pleuronectes flesus*, closely resembling the plaice (q.v.).

Flour and Meal Insects. Various forms of small whitish caterpillars and darker-colored «worms» are commonly found in flour and meal and manufactured cereal products of different kinds. The most prominent of these is the Mediterranean flour moth (*Ephestia kuehniella*), which has been termed a veritable scourge in flouring-mills. It was practically unknown as a pest until 1877, and in North America is still limited to portions of California, Minnesota, New York, and Pennsylvania, where flour-milling is an important industry. The moth has a wing-expanse of a little less than an inch, and is of a pale lead-gray color. The caterpillars are whitish, with long but inconspicuous hairs, and make the trouble while searching for a proper place for transforming to the pupa stage. Wherever it crawls it drags after it a large quantity of silk, with the result that flour becomes felted together and lumpy and the mill machinery gets clogged, requiring frequent and expensive stoppages. The entire life cycle of this insect may be accomplished in 38 days, hence in well-heated mills or other buildings inhabited by the insects from four to six generations may be produced. When a mill is found infested the entire building must usually be fumigated. Sometimes a whole district becomes overrun, and in this case great care must be observed that the insect does not spread from one mill to another. Various remedies are used for eradicating the pest, including the free use of bisulphid of carbon and hydrocyanic-acid gas, the use of «steam-sweepers» and «elevator brushes.»

The Indian-meal moth (*Plodia interpunctella*) somewhat resembles the preceding, but is smaller; the outer halves of the fore-wings are dark greasy brown with metallic reflections, and the larva usually has a reddish or greenish tinge. It has the same habit of webbing up flour, but is not so great a pest as the Mediterranean flour-moth, possibly because it has a larger range of food material, feeding on nearly all forms of dried vegetable matter, among which are dried fruits and jellies, which have earned it the title of «pantry moth.» It is to be found in nearly every store and household, and particularly where dried vegetable foods are neglected for any length of time. The meal snout-moth (*Pyralis farinalis*) is rarer than the preceding, and seldom does injury to flour or meal, although it spoils clover hay.

Two species of beetles (*Tenebrio molitor* and *obscurus*) and their larvæ are popularly known as «meal-worms,» both in this country and abroad. The former is a shining brown beetle over half an inch long, and produces a yellow meal-worm; the latter is dull black, and produces a dark brown meal-worm. They are most apt to be troublesome in dark locations, in feed-stores and in stables; but are useful when raised under control, since they are salable as food for mocking-birds, nightingales, and other cage birds.

Flour beetles or «weevils» are little flattened reddish beetles of the same family (*Tenebrionidæ*) as the meal-worms and are great pests in mills and storehouses. The chief source of annoyance from these insects is due to their imparting a highly offensive and persistent odor to the substances which they infest, which include various drugs, snuff, capsicum, ginger, dried peas and beans, baking powder, nuts, and cabinets of dried insects. Several species occur in America. They differ somewhat in structure and in habits, but may be controlled by the use of bisulphid of carbon.

Flourens, Marie Jean Pierre, mä-rē zhŏṅ pē-är floo-roṅ, French physician and physiologist: b. Maureilhan, department Hérault, 15 April 1794; d. Montgeron, near Paris, 6 Dec. 1867. His first scientific writings, which were distinguished by their perspicuous style and analytical precision, appeared in 1819. In 1828 he was elected a member of the Academy of Sciences, in 1830 was appointed to the chair of comparative anatomy at the Jardin des Plantes, and in 1833 succeeded Dulong as permanent secretary to the Academy of Sciences. In 1840 he was admitted a member of the French Academy. In 1846 he was created by Louis Philippe a peer of France, but he was deprived of this dignity by the revolution of 1848. Flourens combined with profound scientific knowledge great literary talent. His works are very numerous, but the following may be mentioned particularly: 'Recherches expérimentales sur les Propriétés et les Fonctions du Système nerveux' (1824); 'Expériences sur le Système nerveux' (1825); 'Developpement des Os' (1842); 'Anatomie de la Peau' (1843); 'Mémoires d'Anatomie et de Physiologie comparées (1844); 'Buffon' (1844); 'De l'Instinct et de l'Intelligence des Animaux' (1841); 'De la Longévité' (1854); De la Vie et de l'Intelligence' (1858); 'Œuvres de Buffon' (1853–5); 'Des Manuscrits de Buffon' (1859); 'Éloges historiques' (1857). Flourens was the first to demonstrate experimentally that the substance of the animal body undergoes a constant process of renewal.

Flour Milling, American. Flour milling is of two kinds; one the primitive, small industry that supplies a natural local demand; the other a commercial enterprise, which goes into the open markets for its raw material and disposes of its product in the markets of the world. One dates from the early settlement of the country, or as soon as wheat was grown in America; while the other had its beginning about the time of the Revolution, though it assumed no really great importance until after the middle of the last century. While the country has, and probably always will have, a large number of small mills situated in the rural districts, the flour-milling industry proper — considered commercially — is on a larger and more important scale than ever before. In fact, the census of 1900 gives it fourth place among the manufactures of the United States in value of products.

The small mill that supplies a purely local village or rural demand, may properly be termed an «agricultural adjunct.» Therefore the history of farming in this country is the history of the grist-mill development. Yet its early growth is of some interest. In 1626, a horse-power mill was built on Manhattan Island, and a windmill in New England, near Watertown, about two years later. Windmills soon became common on the Atlantic coast. The first water-mill in New England was probably built on the Dorchester side of the Neponset, in 1634. Before the middle of the century, New England was doing an export business, sending wheat and flour to Portugal. In 1649, Virginia had four windmills, five water-mills, and numerous horse-mills, and was also an exporter of wheat and flour. By 1678, New York had a considerable number of mills, and, moreover, had a monopoly on the process of the bolting of flour. The charter was repealed, however, in 1694.

For nearly 100 years following, the development of milling was but the reflection of the growth of the country, with some extension of trade in the West Indies and South America. Still, the process of milling was crude, and the industry, with perhaps a few exceptions, had hardly gone beyond the agricultural or farm-product basis. Not until the mills began to centralize, until «milling centres» began to form, did the industry commence to shape itself on a commercial basis. This period may be said to have commenced shortly after the Revolution. Yet milling then, as compared with to-day, was as the stage coach of 1776 compared with the luxurious express train of the present century. Still, the mills of Delaware, on the Brandywine, were celebrated for their flour. This district had 130 mills within a radius of 40 miles, and Wilmington was an exporter of «superfine» flour.

The next milling centre of importance, and which later became first, was Baltimore. In 1787 the mills of that city made 325 barrels of flour daily, and it was there that the first marked improvements in the process of making flour were adopted. Up to 1785 the different stages of milling were separate and largely done by hand, as they are even to-day in the Hungarian process. But Oliver Evans introduced the elevator and conveyor, and combined the different steps into a continuous system; thus dispensing with much labor, and making a saving in the cost of production. Owing to this improvement and to the slowness of the Delaware millers to adopt it, Baltimore became the more important centre, and the Patapsco River, with its fine water power, became celebrated during the next 50 years. In 1840, the Patapsco, within 30 miles in which the fall is 800 feet, had 60 mills, which ground several hundred thousand barrels of flour a year. A considerable export trade was done with the West Indies.

Still another milling centre was formed at Richmond, Va., at the falls of the James River. The district is now not known as a milling point; the milling business has passed, leaving nothing but a memory of its one-time importance. In 1845, Richmond had the largest mills in the United States, the «Gallego» and the «Haxall.» The number of mills there was 21, and their trade besides the local and nearby territory, was with South America. The «Gallego» mills, in 1864, had 31 pairs of buhrs or millstones, with an annual capacity of 190,000 barrels of flour. The «Haxall» mills had a capacity of 160,000 barrels.

From the Atlantic coast the milling centre began its westward march, following the wheat-fields. Rochester, N. Y., in the Genesee valley, was the next centre, and while it retained its importance for many years, it succumbed to newer districts farther to the west. At one time Cincinnati assumed considerable importance as a milling point, but St. Louis was destined to follow Rochester as the centre of a great milling district. While Rochester at the present writing has lost its importance, St. Louis has retained its mills, but has been outclassed by the younger city of Minneapolis. Milwaukee has also developed a slightly greater milling capacity than St. Louis. Thus the milling centre has finally fixed itself, apparently for all time, at Minneapolis. For many years, however, Rochester was recognized as the first milling city of the country, having as early as 1835, no less than 21 mills, with 95 run of stones. The flour from these mills was sold throughout the Atlantic coast States. In 1865, the flour output of Rochester was 800,000 barrels.

With the development of the great central wheat States, mills were built wherever there was increased population. In 1840, Ohio, Kentucky, Indiana, Illinois, and Michigan had a total of 1,200 mills, producing about 30 per cent of all the flour made in the country, yet very few of them belonged to the commercial class, such as those of the centres. The scattered country mills supplied the farming communities and the small towns, while the few larger mills and those of the centres supplied the large markets and the districts where wheat was not raised.

St. Louis began as a milling point in 1840, with two small mills. The city, due to its location, was then the principal point in the West. By 1860, the St. Louis mills were making 800,000 barrels of flour a year. In 1870 the output was over 1,000,000 barrels, and in 1880 over 2,000,000. St. Louis led all other centres until 1881, when Minneapolis began its rapid development. Among the other important milling centres are Toledo, Buffalo, Detroit, Indianapolis, Chicago, Kansas City, and Milwaukee, already mentioned.

A small, crude mill was built at the Falls of St. Anthony, now Minneapolis, by a detachment of soldiers in 1823, but the first merchant-mill was erected in 1854. The first flour was shipped to the east from Minneapolis in 1859. In 1865, the city had six mills, with a total daily capacity of 800 barrels. It was not until 1878 that the total annual output reached 1,000,000 barrels, and the direct export shipments were about 100,000 barrels.

In tracing the movement of the milling centre, it may be of interest to investigate the causes that brought a large number of milling interests together. The importance of the first milling district, the Brandywine, in Delaware, was evidently principally due to convenient wheat supplies. The Patapsco district owed its importance to fine water power, local wheat supplies, and water transportation, while Richmond would probably never have gained any prominence but for its water power, though its transportation facilities, down the James, enabled it to build up an export trade. The fine water power of the Genesee River, at Rochester, was a natural inducement for the miller to build there, while the rich agricultural valley gave an abundant supply of raw material. Then, too, the opening of the Erie Canal gave Rochester unexcelled transportation facilities to other markets. Until other conditions entered into the situation to affect it, Rochester was particularly favored. St. Louis had no water power, but it had river transportation both for wheat and flour, and it was for years the principal distributing point for a vast territory. Milwaukee was an early wheat market and was the lake outlet for the Northwest before Chicago became a shipping point of importance. It was thus early that mills began to be built at Milwaukee, and its milling importance may be ascribed to its favored position on the lake.

The greatness of Minneapolis as a milling centre is partly due to the water power from the Mississippi River and partly to the position of the city, which is the gateway between the wheat fields and the markets, but it is also largely due to the quality of the wheat of Minnesota and the Dakotas, the greatest spring-wheat territory in the world. Lastly, the pre-eminence of Minneapolis as a milling centre is due to the early business men of genius, who grasped the situation and made the name "Minneapolis" known the world over. Given all the other advantages,—geographical position, water-power, and even the annual production of some 200,000,000 bushels of superb hard spring wheat,—yet without the business genius and enterprise that dominated the early Minneapolis millers, the city might never have been known as the greatest flour-milling centre in the world.

The latest figures at hand show the following flour output at milling centres in the United States:

	Barrels.
Atlanta	315,000
Buffalo	1,415,300
Chicago	1,300,000
Detroit	567,000
Duluth	1,804,400
Kansas City	1,298,300
La Crosse	435,100
Minneapolis	16,329,800
Milwaukee	1,755,000
New York	1,760,700
Nashville	1,000,000
Philadelphia	301,500
Rochester	402,400
Richmond	218,200
St. Louis	1,625,900
Toledo	1,600,000

The present time may be called a commercial era in the flour-milling industry. The period from 1870 to 1900 might fittingly be termed the mechanical era, for during that time greater changes and improvements were made in the process than in all the 200 years preceding it. During the mechanical period, there was also the export era, when the building of new mills and the increasing output of old ones, together with the increase in wheat raising of the country, caused an over-production of flour, if domestic markets alone were depended upon. In fact, the increased output was to keep pace with the growing export trade. After reviewing the natural development of the milling industry, which up to 1870 was identical with the growth of the country, these three divisions,—the mechanical, the export, and the commercial,—seem most important.

No better review of the mechanical period, up to 1895, can be given that that written by the late Charles A. Pillsbury, of Minneapolis, who did more than any other one man to make the city in which he lived, and the wheat of the Northwest, known in every great market of the world.

In 1895, Mr. Pillsbury wrote:

> Down to 1870, the milling process in the United States was that invented by Oliver Evans, with some minor and gradual improvements. From 1787 the nether and upper millstones, the former stationary and the latter balanced to rotate upon it, ground the flour of America. The stones were set close together, to produce as much flour as possible at one grinding. This produced friction and heat, and often brought about chemical changes which injured the color, taste, and quality of the flour. In the early milling history of Minneapolis, when enterprising manufacturers rushed the speed of the stones to secure a large product, the flour came out dark, and so hot the hand could not be held in it.
>
> Minneapolis spring-wheat flour then stood low in the scale, and was sometimes branded, at the request of buyers, "St. Louis flour from winter wheat." The hard spring-wheat, rich in gluten which made it tough, rendered difficult the separation of flour from bran, and thereby yielded a dark-hued flour which brought a low price in the market. The soft and starchy winter-wheat, on the other hand, yielded readily to the old low-grinding process; the bran was more easily separated, and the flour was lighter in color and less damaged by hard-grinding. The color and quality of spring-wheat flour were somewhat improved in the best mills by a reduction in pressure and speed and by scientific stone dressing; but the main difficulty remained. The difficulty in grinding spring-wheat by the old process was with the middlings, or that part of the kernel between the bran covering and the starchy central body. The middlings, although known to be rich in the gluten which gives wheat-flour its chief value with the baker and pastry-cook, were associated with the bran; and the richer the wheat in gluten, as in case of hard spring-wheat, the more difficult was the process of separation, because the gluten was the cause of the toughness.
>
> The first experiments were made with a view to the purifying of middlings. In 1868, E. N. La Croix, a French millwright, came to Faribault, Minn., and experimented in making a middlings purifier, like one he had seen in France. In 1870 he removed to Minneapolis and continued his experiments. At length a machine was made, and a sample shipment of flour was sent to New York. Word came back by wire that the new flour was selling at 50 cents a barrel higher than other brands. The La Croix machine was crude and in some respects unsatisfactory, and George T. Smith produced a superior machine, different in many points, but retaining the same principle, and obtained a patent.
>
> As a result of the new middlings purification process the mills using it added 50 cents a barrel to their profits in the first year, $1 the second year, and from $2 to $4 per barrel the third and fourth years. Thereupon George H. Christian, representing the Washburn mills, a number of head millers from other mills, and myself, representing the Pillsbury mills, went to Europe and made a thorough study of the Hungarian "high-milling" or gradual-reduction roller and middlings process. As a result some of the Minneapolis mills adopted the Hungarian process bodily, middlings purifier and all, and in a few years were compelled to throw away some of the complex machinery with which they were loaded. The Pillsbury mills, however, adopted only what seemed to be the best features of the Hungarian process, such as the rolls, made modifications all along the line, and retained the American middlings purifier invented by Mr. Smith. We found that the Hungarian system needed simplification to increase its efficiency, to save labor, and especially to avoid dangerous accumulation of mill-dust.
>
> The new and improved high-milling system of Minneapolis and Minnesota thus established made the hard spring-wheat of the Northwest the best flour material on the globe, immediately added 10 to 15 cents per bushel to its market value, and gave Minneapolis flour the first place among the cooks and bakers of the world. By the new process chilled iron and porcelain rolls gradually came into use in place of the old millstones. The grain, in place of being ground in a single pair of millstones, was run through six or seven sets of rolls, being sifted and graded after each breaking by the rolls. The old process aimed to get as much flour as possible at one grinding; the new seeks to get as little flour as possible at the first two or three breakings. The old millstones were set so close together that the weight of the upper stone rested almost wholly upon the grain. The first rolls in the new process are set so far apart that the kernel is simply split for the liberation of the germ and crease. The old process sought to avoid middlings as far as possible, because they entailed loss of flour. The new process seeks to produce as much middlings as possible, because out of the middlings comes the high-grade patent flour. In the handlings of the middlings the new process exhibits the highest art. The gluten, which gives flour its strength or rising power, is saved and made available to the baker, and made a prominent source of profit both to the farmer who raises the wheat, the miller who grinds the flour, the baker who makes the bread, and finally to the consumer, in whom it is transformed into brain and muscle.

With the introduction of the new milling process came the big mills which have made Minneapolis famous, and the development of the spring-wheat industry which has made the Northwest known around the globe. In 1884 there were 23 mills equipped with the new process machinery and possessed of a daily capacity of 30,000 barrels.

The number of mills in Minneapolis has not increased since 1884, although the capacity has been largely increased. In 1884 the output was 5,317,600 barrels of flour, while in 1902 it was 16,329,800 barrels. This increase, without even the enlargement of any of the mill buildings, was due to improved and condensed machines. There are seven milling companies in Minneapolis, having 22 mills with a maximum daily capacity of 75,000 barrels of flour. The capacity of the individual mills is from 600 barrels daily to 15,000 barrels. The Pillsbury «A» mill, having the latter capacity, is the largest mill in the world. Four of the seven companies are small ones, having but one mill each. The mills of the three large companies have a maximum daily capacity of approximately 31,000, 27,500, and 18,000 barrels respectively. The greatest actual weekly flour production was 443,800 barrels, for a single week.

Since the discovery of patent flour and the introduction of the rolls, particularly during the last 15 years, the energy and inventive genius of the mill furnishers have been directed toward economy of manufacture, to get the best out of the wheat at the least possible expense. As late as 1900, improvements were made that aided in economy of manufacture, but at this time the limit seems to have been reached in the percentage of high-grade flour that can be produced from the wheat. However, in view of what has been done, one dare not say that still further improvement cannot be made. In this connection a word should be said for patent flour. Much has been written denouncing it as unwholesome and inferior to whole wheat flours; and it has been said that it is over-refined; that the best part of the wheat is eliminated to produce a white flour. All this is without foundation. Chemical analysis and extensive digestive experiments by the United States Agricultural Department prove that white flour bread is not only more easily and completely digested than whole wheat or graham flour bread, but that it contains a greater percentage of the properties that go to nourish the human system. Patent flour is made from the middlings, or that part of the wheat lying between the bran and the starchy central portion of the berry, and it is rich in a high quality of gluten. There is probably no other manufactured article in the world that is sold as cheaply, compared with the cost of the raw material, as is patent flour.

Like the development of milling in this country, the export flour business was not placed upon a high commercial basis until the Minneapolis millers, in the early eighties, began a systematic campaign. From that time until 1900, the export trade increased steadily. Since then some adverse factors, which will be touched upon further on, have arisen. The early mills of the Atlantic coast, as already mentioned, were the first to export flour, probably to meet an actual demand because these mills were the most convenient to buy from, rather than to supply a trade that had been built up by the mills. The early export business doubtless came of itself — a natural demand. The uncertain export flour trade of the first part of the last century reached its climax in the forties, and then, when competition of European mills was felt, dropped off markedly, about the year 1850. During the next 25 years large amounts of wheat were exported annually, while the percentage of the flour production that was sent out of the country was small. The flour trade with the United Kingdom which is now an important part of the export flour business of this country, fell almost entirely away by 1865. This, perhaps, was because the American millers could not hold their own on even terms against the foreign millers, who were then becoming more aggressive and progressive than ever before. The building up of the export flour trade, beginning with about 1875, would make an interesting chapter of commercial history, for this time it was built on a foundation that no fair competition could shake.

The following table, which gives the flour output and the direct export shipments of the Minneapolis mills by years for the last 25 years, will furnish some idea of the development of the export business of the country:

YEAR	Output Barrels	Export Barrels
1902	16,329,800	3,362,300
1901	15,921,900	3,897,900
1900	15,082,700	4,702,500
1899	14,291,800	4,009,100
1898	14,232,600	4,052,600
1897	13,635,200	3,942,600
1896	12,874,900	3,707,300
1895	10,581,600	3,080,900
1894	9,400,500	2,570,700
1893	9,377,600	2,877,300
1892	9,750,700	3,337,200
1891	7,877,900	3,038,100
1890	6,988,800	2,107,100
1889	6,088,900	1,953,800
1888	7,056,700	2,197,500
1887	6,574,900	2,640,000
1886	6,168,000	2,288,500
1885	5,221,200	1,834,500
1884	5,317,700	1,805,900
1883	4,046,200	1,343,100
1882	3,175,900	1,201,600
1881	3,143,000	1,181,300
1880	2,051,800	799,400
1879	1,551,800	442,600
1878	940,800	107,200

A falling off of the exports will be noticed for 1901, which was true also of the general export business of the country. It was not due to the competition of other countries, but to a discrimination in freight rates, inland and ocean, whereby wheat could be exported cheaper, relatively, than flour.

The table which follows gives in condensed form a clear impression of the importance of the flour industry. Only the merchant-mills are considered. Over 5,000 small grist-mills have been omitted, as they properly belong to an agricultural review rather than to a sketch of milling.

A classification of the merchant-mills of the country for 1900 giving the States having a yearly product of $1,000,000 or over, results as shown in the following table — the second column shows the rank of the States.

The census report of 1900 says of flour milling:

«In order to form a correct idea of the magnitude of the milling industry in any given locality, it will be sufficient to compare with the number of establishments, the capital invested and the number of wage-earners employed. For in-

State or Territory	Rank	No. of mills	Raw Material—Wheat: Bushels	Raw Material—Wheat: Cost	Product—Flour: Barrels	Product—Flour: Value	Average daily product	Average value per barrel	Average bus. wheat per barrel	Average cost per bushel
Minnesota	1	324	102,921,426	$66,641,825	22,705,165	$72,381,659	234	$3.19	4.5	$0.65
Ohio	2	744	35,033,213	24,370,443	7,366,474	26,060,827	33	3.54	4 8	.70
Illinois	3	404	27,566,764	18,382,716	6,078,423	20,813,984	50	3.42	4 5	.67
Indiana	4	592	29,192,680	19,188,538	5,818,392	20,384,714	33	3.50	5 0	.66
New York	5	205	25,232,677	18,432,502	5,434,827	19,928,981	88	3.67	4.6	.73
Missouri	6	593	25,368,939	16,263,077	5,245,421	17,800,204	28	3.30	4.8	.64
Pennsylvania	7	1,185	22,923,795	16,179,063	4,775,166	17,059,265	11	3.57	4.8	.71
Wisconsin	8	313	22,356,963	14,869,326	3,750,253	15,496,295	39	4.13	6.0	.66
Kansas	9	260	23,459,171	13,157,846	5,034,251	15,089,529	65	3.00	4.7	.56
Michigan	10	479	20,121,661	13,855,780	4,012,867	14,899,096	28	3.71	5.0	.69
Tennessee	11	337	16,546,155	11,778,868	3,512,985	13,220,609	35	3.76	4.7	.71
Kentucky	12	336	12,325,621	8,294,690	2,549,947	9,341,759	25	3.66	4.8	.67
Texas	13	96	12,228,132	8,046,610	2,604,554	8,881,359	90	3.41	4.7	.66
Iowa	14	327	12,521,953	7,005,972	2,503,390	8,244,050	26	3.29	5.0	.56
California	15	90	12,786,110	7,649,433	2,660,238	7,952,867	99	2.99	4.8	.60
Virginia	16	317	8,562,519	6,025,314	1,758,946	6,671,815	18	3.79	4.9	.70
Maryland	17	235	7,081,937	4,972,234	1,475,416	5,418,734	21	3.67	4.8	.70
Nebraska	18	242	8,687,731	4,546,481	1,821,107	5,319,911	25	2.92	4.8	.52
Oregon	19	124	8,847,242	4,403,048	1,826,512	4,769,373	49	2.61	4.8	.50
Washington	20	57	8,887,996	4,202,920	1,868,780	4,758,004	109	2.55	4.8	.48
North Carolina	21	551	4,549,396	3,609,061	945,761	4,047 340	6	4.28	4.8	.79
Georgia	22	271	4,136,857	2,880,435	789,191	3,431,754	10	4.35	5.2	.70
North Dakota	23	66	4,827,477	2,756,484	1,029,070	3,274,958	52	3.18	4.7	.57
Colorado	24	46	4,869,458	2,716,924	1,012,381	3,063, 00	73	3.03	4.8	.56
West Virginia	25	334	3,813,985	2,680,322	767,160	2,969,298	8	3.87	5 0	.70
Oklahoma	26	30	4,516,858	2,440,518	975,870	2,855,216	108	2.93	4.6	.54
South Dakota	27	80	4,427,426	2,380,818	915,541	2,695,024	38	2.94	4.8	.54
Arkansas	28	158	2,912,566	1,840,529	605,702	2,005,295	13	3.31	4.8	.63
New Jersey	29	119	2,404,670	1,743,080	466,338	1,871,129	13	4.01	5.2	.72
Utah	30	72	2,546,801	1,217,169	513,692	1,413,428	24	2.75	5.0	.48
Total		8,987	481,658,179	$312,632,026	100,823,820	$342,119,777	37	$3.39	4.8	$0.65

stance, in the State of Minnesota, there were 512 milling establishments (including small grist-mills not included in the foregoing table) representing a capital of $24,125,781, and employed 4,086 wage-earners. The average capital invested for each establishment was $47,121, and the average number of wage-earners for each establishment was eight. Compare with this some other locality having approximately the same number of establishments, for instance, Arkansas: the total number of establishments in Arkansas was 410, representing a capital of $1,183,052, the number of wage-earners was 443, the average capital for each establishment was $2,885, and the average number of wage-earners for each establishment was one. Again, in the case of South Carolina, the total number of establishments was 556, the capital invested was $652,553, the number of wage-earners was 281, the average amount of capital invested in each establishment was $1,174, and the average number of wage-earners was only about equal to one for every two establishments in operation."

The following table shows the number of flour-mills having an annual production of 1,000 or more barrels, in States having a cereal mill product of $1,000,000 and over in which wheat flour is the chief product. (Many small mills grind rye and corn principally, and a little wheat):

States and Territories.	1,000 to 4,999 bbls.	5,000 to 19,999 bbls.	20,000 to 99,999 bbls.	100,000 bbls. or more
United States	4,310	2,584	634	135
Alabama	17	3	1	....
Arizona	4	5	1	....
Arkansas	71	34	2	....
California	30	28	11	6
Colorado	12	12	17	1
Connecticut	....	....	....	....
Delaware	27	7	1	....
District of Columbia	....	....	2	....
Florida	....	....	....	....
Georgia	76	9	5	1
Idaho	11	17	4	....
Illinois	129	131	50	12
Indiana	245	235	44	8
Indian Territory	8	12	3	....
Iowa	129	107	21	2
Kansas	73	97	48	13
Kentucky	170	117	17	1
Louisiana	....	....	....	....
Maine	7	1	....	....
Maryland	128	36	6	2
Massachusetts	2	....	....	....
Michigan	236	137	37	4
Minnesota	93	151	52	24
Mississippi	2	....	....	....
Missouri	330	165	44	9
Montana	4	7	4	....
Nebraska	93	110	18	....
Nevada	9	1	....	....
New Hampshire	....	....	1	....
New Jersey	59	27	1	....
New Mexico	19	9	....	....
New York	127	80	23	14
North Carolina	202	36	1	....
North Dakota	23	25	17	1
Ohio	375	282	51	5
Oklahoma	6	14	13	1
Oregon	48	52	13	3
Pennsylvania	556	185	25	5
Rhode Island	....	....	....	....
South Carolina	39	8	1	....
South Dakota	27	55	7	....
Tennessee	209	98	16	6
Texas	23	42	25	6
Utah	42	33	3	....
Vermont	1	....	....	....
Virginia	281	56	12	1
Washington	12	24	16	4
West Virginia	151	29	5	....
Wisconsin	260	103	16	6
Wyoming	4	4	....	....

One of the more recent features of the flour trade has been the considerable business by Minneapolis mills with Australia, the direct result of the crop failure there in 1902. Minneapolis mills also send flour to South Africa, and have made trial shipments to China, and there is a possibility of a trade being developed in the Far East. Pacific coast mills have introduced their flour in China and Japan, but as yet those countries are not bread-eaters. The northern transcontinental railroads, which will soon connect with an Asiatic steamship line owned by one of the roads, promises to revolutionize some of the native customs. And if China can be induced to become a bread-eater, the export flour business via the Pacific will increase very rapidly.

Commercially, the flour-milling industry has made as great progress as it has mechanically. As the skill of the mill furnisher and the operative miller has separated the best parts of the wheat into a refined and delicate product, yet retained the most wholesome and nourishing properties, as compared with the dark and coarse flour of an earlier milling age, so the work of the merchant miller of to-day differs from that of the miller of the early part of the last century.

Milling is now more a commercial and less a mechanical proposition than ever before. Mechanical perfection has nearly been reached; and it is easier to keep a machine running smoothly than to invent and perfect the machine. Perhaps the greatest commercial problem is that of competition, not only of individual millers, but of nations. It is first a competition for the raw material, and then for the flour trade. Almost every country desires to be a manufacturing nation to some extent, whether a wheat-growing country or not, therefore encouragement is given to home industries. Then, too, Europe buys large quantities of American wheat when the price is low, and later this enters into competition with American flour in foreign markets. Therefore, the flour trade is on a world-wide basis, and the large miller, more than ever before, has great commercial, rather than mechanical, problems to solve. Never, however, will he feel they have all been solved, until the United States exports the surplus of its wheat crop as the manufactured article of flour, rather than a large part of it as raw material.

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Flour, Wheat, a finely ground meal used for food. Ordinary white or bread flour, of which there are a number of grades, is composed of the interior portion of the wheat kernel subjected to processes of pulverization and purification. In the preparation of white flour either a portion or all of the bran, germ, and other offal parts are removed. When the entire wheat kernel is ground into a meal, it is called graham flour. When a portion of the bran is removed but the germ and fine bran are retained, the product is called purified graham or entire wheat flour.

The history of wheat milling shows that many and gradual changes have taken place since the early times when wheat was pulverized between stones to the present time when it is reduced by steel rolls. Wheat has variously been reduced to flour by means of stone crushers, saddle stones, and stone mortars. The ancient Greeks, Romans, Chaldæans, and Egyptians used saddle stones for grinding wheat into flour, the wheat being placed in a concave stone and rubbed with a convex stone rocked backward and forward. Saddle stones are still in use among the native Africans, and are known to have been used from earliest times. They are also found among the remains of the prehistoric Swiss lake-dwellers and mention is made of them in the earliest literature. Their use appears to have been common among all primitive races and they are in use to-day by many barbarous and half-civilized nations. Near the beginning of the Christian era, querns or crude crushers in which the parts were fitted mechanically came into use. The upper stone or pestle revolved upon the lower concave stone. The quern was the forerunner of the millstone. Querns are still in use in some Asiatic and European countries. The millstone came into use about the 14th century and was the result of gradual evolution from the stones shaped by nature and operated by hand to specially hewn and dressed millstones propelled by various forms of motive power. In ancient times, flour was prepared in each household, the grinding being done by women, slaves, and menials. During the Middle Ages when the feudal system was at its height, crude flour-mills or querns formed a part of the outfit of each castle or estate. In some countries, the right to operate these mills was vested in the clergy, and in early English history frequent mention is made of contests between the people and the landlords and clergy relative to their right to operate these mills or querns.

Until the beginning of the 17th century wheat milling was simply a crude agricultural industry, the earlier mills being operated by slaves, then by oxen. Later water wheels and windmills were used as motive power. About 1820, a flour-mill was first operated by steam. At the present time, some mills are operated by electric power.

About 1870 the present roller process of flour production was introduced from Hungary into America. The process consists of the gradual reduction or pulverization of the floury portions of the wheat kernel between corrugated and smooth steel rolls and of the purification of the product by means of aspirators, sieves, and bolting cloths. During the process of milling, the granular middlings undergo gradual reduction and are passed from break to break. At each break or grinding, the fine flour is removed by bolting, the middlings are separated and passed to other rolls and the tailings are subjected to further reduction. Before passing to the rolls, the wheat is screened to remove loose dirt and weed seeds, and occasionally washed to remove adhering dirt and debris; then dried or tempered with steam, as may be necessary in order to more easily effect reduction. The first break simply flattens the kernels after splitting them in halves along the longitudinal groove. The germ is pinched off by the rolls and is readily separated. The flour passes automatically from one break or set of rolls to another. Each break is regulated so as to pulverize a little finer than the preceding one. Each stream is purified by passing through reels and by subjection to aspirators which remove the fine dust and dirt by suction. Finally the various streams are blended so as to form different grades of flour. In large mills, the cleaned wheat is usually elevated to the top of the mill, and then passed on to the rolls, and the various streams blended in such a way that the final flour product is obtained after being separated into 40 or more separate streams.

The introduction of the roller process of miling has made it possible to use varieties of wheat from which high-grade flour could not be made by the old stone process. By the roller process of reduction, the granular middlings which were formerly excluded from the flour and sold as a distinct product for animal feeding are now reduced and added to the patent grades of flour. About 75 per cent of the cleaned wheat is returned as merchantable flour, 72 per cent being straight grade or ordinary white flour. In ordinary milling, the grades are as follows: (1) first patent; (2) second patent; (3) straight, sometimes called standard patent; (4) first clear; (5) second clear; (6) red dog. First patent flour is the highest grade manufactured. Its gluten has greater power of expansion and absorbs more water than that from any other grade. First patent flour produces the whitest and largest sized loaf of bread. Second patent flour is similar to first patent, but the bread is slightly darker in color and the gluten does not possess quite so high a power of expansion. First clear grade flour is obtained after the removal of the first and second patent grades. This flour is slightly darker in color and produces a smaller sized loaf than the patent grades. Second clear or low grade is the name given to a small amount of flour obtained after the removal of the first clear. About 12 per cent of the cleaned wheat is recovered as first clear flour and about .5 per cent as second clear or low grade. When the wheat is milled so that the first and second patents and the first clear are all obtained as one flour, the product is called straight grade. This is the flour that is most extensively used for bread-making purposes. Straight flour is the sum of the first and second patents and the first clear. The lowest grade of flour manufactured is called red dog; it is dark in color and possesses but little power of expansion. It is secured largely from those portions of the wheat kernel adjacent to the germ and aleurone layers. Red dog flour is not generally used for human food, but is employed in the arts, as for foundry purposes, for the feeding of animals and occasionally in the preparation of some cereal breakfast food. It has a high per cent of protein or nitrogenous material, but is not valuable for bread-making purposes because the gliadin and glutenin (see BREAD AND BREAD MAKING) are not present in the right proportions to form a balanced gluten. By blending the different standard grades of flour, various commercial grades sold under different trade names are secured. The composition and properties of different kinds of flour result from the kind of wheat used in preparation (see WHEAT) and the method of milling employed. The percentage amounts of bran, shorts, and standard grades of flour obtained by the roller process vary with different kinds of wheat. Some wheats yield more flour than do others. The average yields are approximately as follows:

	Per cent of cleaned wheat recovered
1. First patent	56.0
2. Second patent	60.8
3.* Straight or standard patent	72.6
4. First clear or first bakers	11.8
5. Second clear or low-grade	0.5
6. Red dog	1.9
7. Shorts middlings	11.6
8. Bran	13.4

*Straight grade flour is composed of first and second patents and first clear grade.

By the roller process of milling, the germ is excluded because of its poor bread-making properties and its fermentable nature. The wheat offals of which shorts and bran form the main portion are by-products used for the feeding of animals. About 25 per cent of the cleaned wheat finds its way into the offals. Bran is the episperm or outer covering of the wheat kernel. As human food, it is indigestible and does not contain any appreciable amount of available nutrients. As an animal food, however, it has a high value. Shorts consist mainly of the fine bran mixed with some of the floury portions of the wheat kernel. When the wheat screenings, consisting of weed seeds and other refuse are ground and mixed with the shorts, the product is known as shorts feed. When the germ is mixed with the shorts, the term shorts middlings is used. By some processes of milling, the germ is obtained separately. From 5 to 7 per cent of the weight of the cleaned wheat is recovered as germ.

Wheat flour is composed of starch, gluten proteids, water, fat, ash, or mineral matter, and small amounts of other compounds, as sugars, cellulose, organic acids, amids, etc. The proximate composition of the different kinds of flour when milled from the same lot of hard wheat is given in the following table:

	Water, Per Cent	Protein (Nx 5.7) Per Cent	Fat Per Cent	Carbohydrates Per Cent	Ash Per Cent	Phosphoric Acid Per Cent	Acidity Per Cent	Heat of Combustion per Gram, Determined, Calories
Wheat	8.50	12.65	2.36	74.69	1.80	0.75	0.18	4.140
First patent flour	16.55	11.08	1.15	76.85	.37	.15	.08	4.032
Second patent flour	10.49	11.14	1.20	76.75	.42	.17	.08	4.006
Straight flour	10.54	11.99	1.61	75.36	.50	.20	.09	4.050
First clear grade	10.13	13.74	2.20	73.13	.80	.34	.12	4.097
Second clear grade	10.08	15.03	3.77	69.37	1.75	.56	.27	4.267
Red dog flour	9.17	18.98	7.00	61.37	3.48	....	.59	4.485
Shorts, middlings	8.78	14.87	6.37	65.47	4.56	....	.14	4.414
Bran	9.99	14.02	4.39	65.54	6.06	2.20	.23	4.198

From the table, it will be observed that there is a gradual increase in the amount of ash, proteids, and fat from the first patent flour to the red dog or lowest grade of flour. In fact, the variations in ash content of the different grades of flour are so regular that the percentage of ash can be taken as an index to the grade of flour. The highest grade flours, as first patent, contain least ash because of the more perfect exclusion of the bran and endosperm parts. There is but little difference in chemical composition between the first and second grades of patent flour, second patent, containing more fat, slightly more protein and germ, and less carbohydrates than first patent. In the straight grade or ordinary bread flour, there is only from .6 to .7 per cent less nitrogenous material as proteids than in the wheat from which it was milled. Second clear and red dog flours contain a large amount of protein, fat, and ash, and judged by their proximate composition only, would appear to have a higher nutritive value than the patents or straight grade flours. But when judged on the basis of digestibility, available nutrients and physical character of the bread, these flours are found to have a much lower value than the patents or straight grade flours. For nutritive values, see article on Bread and Bread Making. During the process of milling, the flour particles pass through bolting cloths containing from 12,000 to 16,000 meshes per square inch, which results in even and fine granulation of the flour particles. The character of the flour particles as angular or spherical depends largely upon the character of the wheat, as hard or soft, and to a less extent upon the method of milling. The flour granules from hard wheat are angular and have a sharp feeling akin to fine sand, while soft wheat flours produce small spherical particles lacking in gritty feeling.

In the testing of flour, particular attention is given to physical characteristics, as color, purity as indicated by absence of dirt and fine pieces of bran, capacity to absorb water, quality of gluten and character of the bread product. For bread-making purposes, the quality of the flour depends largely upon the amount and quality of the gluten. The gluten is obtained by making a stiff dough of the flour and then washing this dough with an abundance of water, which removes the starch, leaving the gluten in the form of a gum-like mass. Gluten from high-grade flours is firm, elastic, white or of slightly yellowish tinge and possesses good qualities of expansion. Poor gluten is dark in color, sticky and lacking in elasticity. The color of the flour depends largely upon the quality of the wheat and the method of milling employed. Some wheats produce creamy or yellowish flours, others chalk white flours and others dark-colored flours. Dark-colored flours, however, produce bread of inferior quality; creamy and white flours producing the best grades of bread. The granulation of the flour is also taken as an index of its quality, as it reveals to the experienced miller and baker the character of the flour. Comparative baking tests are generally resorted to in order to determine the bread-making value of flours. By these tests, under uniform conditions with the same amount of flour, yeast, water, etc., in each case, differences in the bread-making qualities of the flour are readily revealed. When flour is stored for a long time, it sometimes becomes inferior through fermentation changes. Ordinarily, flour will not deteriorate until after it has been kept for 10 months or more. Some wheats produce flours of better keeping qualities than do others. The soundness of the wheat, as freedom from rust, smut or other blemishes, influences the keeping qualities of flour as well as does also the process of milling, particularly the extent to which the cleaning and purification are perfected.

Wheat flour is not ordinarily adulterated, although at times attempts have been made to add other cereals and mineral adulterants. The national flour law requiring all mixed flours to be branded has prevented extensive adulteration. At one time, corn flour produced by milling corn, was used for adulterating wheat flour. This, however, was only practised for a very short time when corn was cheap and wheat was high in price. The blending of wheat and corn flours has never proven successful and the practice since the passing of the national flour law has been discontinued. Wheat flour appears to be less subject to adulteration than many other articles of food. See Adulteration.

Wheat flour is used not only for bread making but for other purposes. Crackers, cakes, pastry and many food articles are made largely of flour. Flour is also used in the arts and industries and in various manufacturing operations. The comparative value of bread made from different kinds of flour, as graham, entire wheat and straight, is discussed in the article Bread and Bread Making.

It is estimated that four and a half bushels of wheat, equivalent to about 200 pounds of flour, are consumed annually per capita in the United States. The consumption of flour as food has, during recent years, gradually increased. Some political economists and scientists have feared that at no distant date the consumption of flour would exceed the production of wheat. But improved methods of agriculture and the opening up of large tracts of land suitable for wheat culture, as in northwestern Canada, render this improbable. From earliest times wheat and wheat flour have taken an important part in the dietary of man and there is every reason to believe that it will continue to be one of his staple articles of food. The extent to which it should be used in the dietary depends largely upon the individual and the cost of food. Ordinarily wheat flour is one of the cheapest articles of food, and when it forms a part or even the main portion of a ration, it supplies a large amount of nutrients in a digestible form and at a low cost.

Harry Snyder,
Professor of Agricultural Chemistry, University of Minnesota.

Flow'er, Benjamin Orange, American editor and author: b. Albion, Ill., 19 Oct. 1858. He was for some years the publisher and editor of the 'Arena' at Boston. Among his numerous works are: 'Civilization's Inferno; or Studies in the Social Cellar' (1893); 'The New Time' (1894); 'Persons, Places, and Ideas'; 'Gerald Massey: Poet, Prophet, and Mystic' (1895); 'The Century of Sir Thomas More' (1896); 'Lessons Learned from Other Lives.'

Flower, Frank Abial, American historical writer: b. Cottage, N. Y., 11 May 1854. Has written several local histories: 'Old Abe, the Wisconsin War Eagle' (1880); 'The Life of Matthew H. Carpenter' (1883); 'History of the Republican Party' (1884).

Flower, Roswell Pettibone, American financier: b. Jefferson County, N. Y, 7 Aug. 1835; d. Eastport, Long Island, 12 May 1899. He began his business and political career in Watertown, N. Y., where he organized the Jefferson County Democratic Club. His success in politics attracted the attention of Samuel J. Tilden, through whose influence he was appointed chairman of the Democratic State Committee in 1877. Four years later he was elected to Congress, and in 1886 was appointed president of the Subway Commission. He was re-elected to Congress in 1888 and 1890, and in 1891 was elected governor of New York. From the close of his term till his death he applied himself to the interests of his large banking house and to a systematic course of philanthropy.

Flower, Sir William Henry, English zoologist: b. Stratford-on-Avon 30 Nov. 1831; d. London 1 July 1899. After a medical training he served as an assistant-surgeon in the English army during the Crimean war; in 1861 was appointed conservator of the museum of the Royal College of Surgeons; and in 1870 Hunterian professor of comparative anatomy in the same institution. In 1884 he was appointed director of the natural history departments of the British Museum, which two or three years before had been removed to their new quarters at South Kensington. From this post he retired in 1898. In 1889 he was president of the British Association meeting at Newcastle-on-Tyne. He was made a knight commander of the Bath in 1892. Several important treatises came from his pen, including 'Introduction to the Osteology of the Mammalia' (1870, 3d ed. 1885); 'Fashion in Deformity' (1881); 'Introduction to the Study of Mammals, Living and Extinct' (1891); 'The Horse: a Study in Natural History' (1892); and 'Essays on Museums and other Subjects connected with Natural History' (1898).

Flower, that part of the spermatophytous (phanerogamous) plant which consists of the organs of reproduction, frequently, but not necessarily, accompanied by protecting envelopes. In common usage, the word "flower" is applied to those related structures only in which one or both sets of floral envelopes are present and rather conspicuous.

Parts: Their Position and Functions.— The end of the flower stalk upon which the parts of the flower are grouped is known as the torus or receptacle. In a complete flower the floral envelopes are double, composed of two whorls or circles, alternating with each other; the outer series consisting commonly of green or greenish leaves named sepals, and together forming the calyx; and the inner series, of leaf-like parts, usually of a delicate texture, and of some other color than green, named petals, and together constituting the corolla. The term perianth is sometimes applied to the floral envelopes taken together, but it is generally restricted to those flowers in which only one of the series is present, at least in appearance, as in the lily, and in the common marsh-marigold; or in other instances where the limits of the calyx and the corolla are not easily distinguished. The organs of reproduction are the stamens, or fertilizing organs, forming a whorl within the floral envelopes and known collectively as the andrœcium; and the pistils at the centre of the flower, containing the ovules or undeveloped seeds, and known as the gynœcium. The essential part of the stamen is the anther or pollen sac, having usually two cells attached by a connectile to one another and to the stalk, called a filament, at the summit of which they are placed. The insertion or place of attachment of the stamens varies. In the lily, the buttercup, and the marsh-mallow the stamens are seen to arise directly under the gynœcium, and are accordingly described as hypogynous; in the strawberry and cherry they arise in a higher circle and upon the calyx and are termed perigynous; while in the iris, the rose, and blueberry they are inserted upon the top of the ovary, and are said to be epigynous. (Plate I., Figs. 3, 4, 5.) In the absence of the filament the anther may be sessile on the receptacle, calyx, petals, or ovary, or be adherent to the style (as in *orchis*). The essential parts of the pistil are the ovary and the stigma. The former is the rudimentary seed vessel. The latter, which is intended to receive the pollen upon its viscid surface, is connected with the ovary by a stalk known as the style, or is sessile upon it, as in the poppy. The pistil may be formed of a single carpel or of a number of carpels united by their lower parts to form a compound pistil. The number of carpels represented in such a pistil may be determined by the number of styles; by the number of free stigmas (though a single carpel is sometimes accompanied by a two-lobed stigma); by the seams, lobes, or angles of the ovary; by the cells, by the character of the placenta, or ovule-bearing portion of the carpel. The ovules, or rudimentary seeds, are borne upon the inner or ventral suture formed by the united edges of the carpellary leaf constituting the seed-vessel. In a "compound" pistil the single carpels may be closed, as in a "single" pistil, and joined at their sides and ventral sutures; or they may be open and joined by their edges. In the first case there will be in the compound ovary, as many cells as there are carpels, and the placentæ will meet at the axis. In the second there will be but one cell and the placentæ will be parietal. There are, however, many intermediate conditions, as in the poppy where the inflected margins of the carpels carry the placentæ to the centre. The apparent anomaly of a free axial placenta in the single cell of a compound ovary is found in the purslanes and in the pinks. The delicate partitions or dissepiments have very early disappeared. The ovules vary in number from one to hundreds. They are sessile or borne on a stalk called the funiculus. In direction they are horizontal, ascending (pointing obliquely upward), erect from the base of the cell, pendulous from near the top of the placenta, or suspended from the summit. The ovule-body is surrounded by an integument of one or two coats, which does not meet at the summit. The minute opening thus left is known as the micropyle. Within the ovule-body is the embryo-sac, which contains the endosperm and one or more germ-cells. The simplest form of pistil is that of the gymnosperms, which consists of open scales bearing two or more ovules on the inner face next the scales.

The chief function of the calyx is protection, an office which it shares with the corolla, especially while the more delicate organs are in the bud. When the corolla is lacking, the calyx frequently assumes some of its characteristics, becoming more conspicuous and of finer color and texture, the marsh-marigold and purple clematis furnishing examples in point. The bright hues or markings of the corolla serve to attract the insects that play such an important part in the pollination of the flower. The andrœcium has for its function the producing and scattering of the fructifying pollen, which falls from the anthers when they open at maturity. The gynœcium is devoted to the development of seed from the ovules.

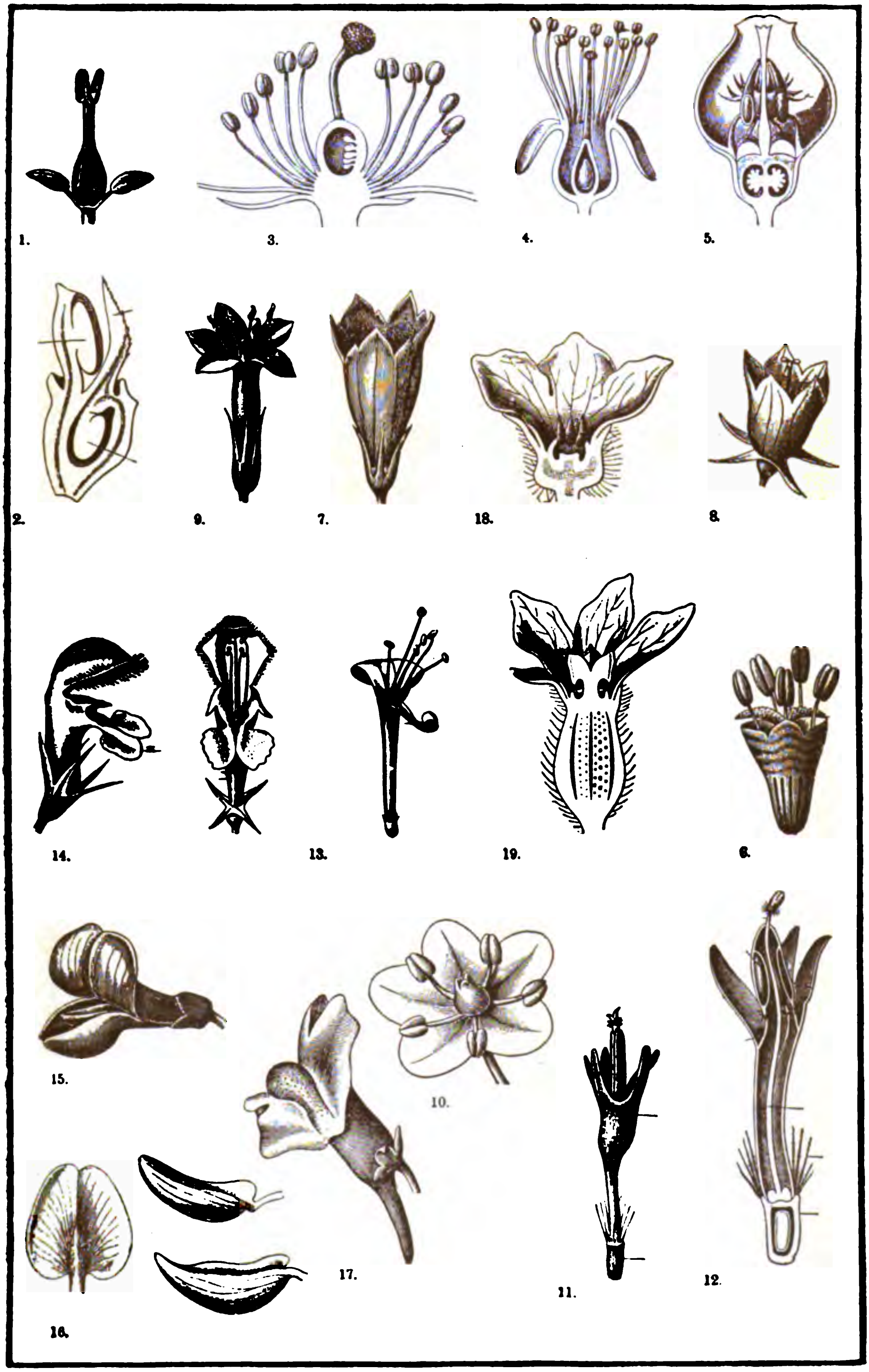
Evolution of the Flower.—The recognition of the flower as a modification of the stem and leaves, adapted to the purposes of reproduction, gives a key to its morphology, throwing light on innumerable variations of arrangement and structure and even on such details as scent, color, and the production of nectar. This conception of the flower was of fundamental importance in the transition from the artificial to the natural system. The shortening of the axis aggregates the transformed leaves and a growth is produced in which the arrangement of the true leaves on the stem is still the regulating principle, whether there be an alternating succession or a whorled (cyclic) grouping, the more developed flowers following the latter order, with limited number of parts, generally definite for certain large groups. Flower buds, like leaf buds, are terminal or axillary. The prefloration or æstivation of the sepals and petals, individually considered, is similar to that of leaf buds, being convolute, revolute, or involute. The metamorphosis of the leaf is easily traced in certain flowers. In the peony the transition from leaves to bracts and thence to petals is gradual, as is the change in the sweet-scented shrub (*Calycanthus*) from sepals to petals. In the white water-lily the gradations between the pistil and stamen are finely illustrated. It does not follow that the order of development is from the former to the latter. That the essential organs are of earlier origin than the floral envelopes is indicated by the fact that the latter are wanting in the gymnosperms, which are older and less developed forms than the phanerogams (spermatophytes). In the anther we recognize the infolded leaf-blade, in the filament its petiole, and in the pollen a development from the parenchyma. In the pistil the carpellary leaf may be traced, with its lengthened apex forming the style. The double-flowering cherry offers an interesting example of the reversion of the pistil to the form and color of the true leaf. The interpretation of the ovule as a transformed bud upon the edges of the carpellary leaf is confirmed by the fact that the leaves of *Bryophyllum* and certain other plants produce buds upon their margins or upper surface. Even the stipule of the leaf has its homologue in the floral structure. What is called the outer calyx or epicalyx of the strawberry may be regarded as the united stipules of adjacent sepals. That portion of the stem which becomes the floral axis sometimes undergoes striking modifications in its function as a receptacle. In the wild geranium it is extended into a slender beak, while in the rose-hip it becomes urn-shaped. The fig and the strawberry are succulent receptacles, the one hollow and the other convex. In investigating the morphology of the flower it was formerly the method of botanists to start from an ideal type and to consider as mere modifications of that type all forms that differed from it. A later view admits the probability of various independent lines of development. Those types are the simplest in which the floral structure is nearest to the original arrangement, the parts being more definitely separated. Union of parts indicates as a rule greater complexity of type, though simplicity of structure may in some cases be an indication of degeneration. Simplicity of type is illustrated by the water-lily family (*Naiadaceæ*), and complexity by the orchids (*Orchidaceæ*) and the thistle family (*Compositæ*).

Although the morphology of the flower continues to be of paramount importance in the classification of plants, the application of the principles of evolution to the study of botany has inevitably led to a method differing from that formerly in use. The 24 classes into which Linnæus divided plants were (with the exception of the cryptogams) based on the length, number and other characteristics of the stamens; and the classes were divided into orders chiefly according to the characteristics of the pistil. In the system worked out by the French botanists and known as the «natural» system stress was laid upon the characteristics of the perianth, the presence or absence of a corolla and the union or separation of petals. In a system based on the facts of development the fundamental division into monocotyledons and dicotyledons may still be maintained, though late methods do not recognize the likeness existing between adult forms as sufficient to place them in the same group, classification proceeding rather on the principle that relationship is more convincingly shown by similarity in manner of reproduction and in laws of growth.

Variation in Structure and Arrangement.— Flowers are said to be perfect when they are provided with both kinds of essential organs; complete when calyx and corolla are also present; regular when all the parts of each set are alike in shape and size; and symmetrical when they have an equal number of parts of each kind. In the monocotyledons the parts are in threes; in the dicotyledons mostly in fives or fours. The perianth of the lily, though apparently having six in a set, has really three sepals and three petals, as is plainly shown in the bud. Apparent violation of the law of symmetry may in certain cases be due to adhesion, abortion or non-development of floral plants. In the mustard family, though the calyx and corolla are in fours, the stamens are generally six. The suppression of two stamens would account for lack of symmetry. An instance of non-development is found in the monkshood, where the sepals number five and the petals two, while three very minute rudimentary petals are sometimes discernible. The violet, although symmetrical as to sepals, petals, and stamens, which are in fives, has a simple stigma and three-valved seed-vessel. The flax is a good example of a symmetrical and regular flower. The irregularity of the flower may be shown in any of its parts, but is most striking in the peculiar forms often assumed by the corolla and calyx, most curious instances being seen in the orchids, a family in which the morphology of the andrœcium and gynœcium are also of especial interest.

Certain variations of form may be traced to the visits of insects, as where such a visitant alighting always on the same side of the flower tends by its weight to increase the size of that part or to thicken the tissue, etc. The chief irregularity of some corollas consists in having one or more spurred petals. This deviation from the ordinary petal shape is common and sometimes serves the purpose of providing flowers with nectaries, as in the case of the violet, the toad-flax, and the columbine. In the nasturtium it is the calyx spur that constitutes the nectary. Less noticeable modifications in the petals of other flowers have the same function, as the scales on the petal-claws in the crowfoots and the pits in the petals of lilies and fritillaries. The irregularity illustrated in the blossoms of the pea and the bean is of a very common kind. This butterfly or papilionaceous corolla marks

MORPHOLOGY OF FLOWERS.—I.



1. Ash flower. 2. Section of flower of Hippuris. 3. Hypogynous flower (sun-rose). 4. Perigynous flower (cherry). 5. Epigynous flower (whortleberry). 6. Flower of Elm. 7, 9. Funnel-shaped corollas of Gentian. 8. Bell-shaped corolla 10. Rotiform corolla. 11. Tubular corolla (bluebottle). 12. Sections of bluebottle. 13. Two-lobed flower. 14. Labiate flower. 15. Papilionaceous corolla. 16. Parts of a papilionaceous corolla 17. Personate corolla (spurred). 18. Male (staminate) flower (melon). 19. Female (pistillate) flower (melon)

the family to which these legumes belong. In the case of gamopetalous (sympetalous) corollas it is convenient to speak of the parts of the more primitive or separated type as having coalesced, even if the growth be regarded as undivided from the beginning. The regular five-petaled corolla has its homologue in such a gamopetalous corolla, as that of the campanula (Plate I., Fig. 8), where the five lobes correspond to the separate petals and maintain the numerical scheme of the flower. The labiate or bilabiate (two-lipped) corolla is the characteristic form of the mint family (*Labiatæ*), and of the figworts (*Scrophulariaceæ*), the ringent or gaping corolla of the dead-nettle (Plate I., Fig. 14) and the personate corolla of the snapdragon and toad-flax being variations of the type. Not only is a union of parts frequent in the corolla and the calyx, but it has its counterpart in certain forms of the andrœcium and the gynœcium. The filaments of the lupine arise as a single cylindrical growth and, the syngenesious anthers of the *Compositæ* are a pre-eminent characteristic of that large family. The combination of several carpels to form one pistil has already been referred to, complete union being found in the rhododendron among other instances, and the gynœcium takes a great variety of forms according to the degree of distinctness maintained by the separate parts of the contiguous carpels.

Fertilization.—Flowers which are achlamydeous, that is, destitute of floral envelopes, may be unisexual or bisexual (androgynous). The male (staminate) flowers and the female (pistillate) flowers may be found upon the same plant, which is then termed monœcious, the alder, oak, ragweed and begonia being examples; or the staminate flowers of a species may be produced by one plant and the pistillate by another, the plants being then diœcious, as in the willow family (*Salicaceæ*). The neutral flower is one lacking both kinds of essential organs, as is the case with the ray flowers of many *Compositæ*. The showy snow-ball tree and the garden hydrangea are examples of development of such flowers by cultivation, the neutral flowers being found only on the margin of the flower cluster in the wild species. Close fertilization, that is, the fertilization of a flower by its own pollen, is rendered impossible by the unisexual arrangement, but so long as the transfer may be from flower to flower on the same plant the advantages of cross-fertilization strictly so-called (that is, from plant to plant) are not positively insured. Diœcious flowers might be expected to prove better producers of seed, as close fertilization would naturally be looked for in bisexual flowers, and indeed was formerly considered the normal method, but it is doubtful if there is any species of which it could be proved that its flowers are without exception self-fertilized. By the dichotomy of some species of bisexual flowers (that is, by a difference in the time when the essential organs mature) the pollen is set free before the stigma is ready for pollination, the latter being accordingly obliged to rely upon pollen from without. In other cases the structure of flowers is of such a nature that fertilization by their own stamens is guarded against.

Agencies for the transportation of pollen are various. Flowers dependent upon the wind, like those of the date-palm, are known as "anemophilous"; those for which insects are the carriers are "entomophilous." (See FLOWERS AND INSECTS.) Many plants bear two kinds of blossoms, conspicuous, nectar-producing flowers, which are entomophilous, and inconspicuous, later-blooming blossoms in which close fertilization takes place. Certain species of violets have the two forms, their later flowers never opening nor developing petals, but becoming fertilized in the bud. Contrary to the law which generally controls fertilization, these cleistogamous blossoms are more fruitful than those on the same plant open to cross-fertilization. Whatever be the method of pollination, the pollen-grain when it falls upon the stigma absorbs the moisture of the surface and germinates. It then sends down a tube which passes through the tissues of the style and stigma and on reaching the cavity of the ovary enters the micropyle and penetrates to the embryo sac. Sometimes the latter has grown out to the micropyle, or even through it, to meet the pollen-tube. The chalaza, or point of attachment of the ovule, is in a few instances the place of entrance for the pollen-tube. The transfer of the contents of the pollen-tube to the germ-cell in the embryo sac takes place, thus fertilizing the cell, which begins to grow and divide, developing the embryo plant, at first nourished by the endosperm, or albuminous contents of the sac.

Colors of Flowers.—The colors of flowers have been arranged in two series, the blue and the yellow, in both of which red and white are found, green being produced by a blending of the two. It has been estimated that in an average collection of 1,000 plants about 284 have white flowers, 226 yellow, 220 red, 141 blue, 73 violet, 36 green, 12 orange, 4 brown, and 2 black. White flowers are more generally odoriferous than those of other colors, and their odors are almost always agreeable. Red flowers, though less numerous than yellow ones, are more often fragrant. The tints are due to fluid or viscous matters contained in superficial cells and can be separated in certain cases by solution in water and in others by solution in alcohol and ether. Attempts have been made to refer the coloring matters to one or two principles, which have been described under the names of xanthin, xanthein, anthoxanthin, and cyanin and anthocyan. These bodies, however, are very ill defined and are in all probability mixtures, even supposing that when obtained from different sources they are essentially the same. The chief difficulty is to obtain the coloring matters in sufficient quantity for investigation and then to separate them accurately from each other which, as they are amorphous, uncrystallizable bodies, is not easy to accomplish satisfactorily. Of the coloring matters from flowers one of the most individualized is the yellow body obtained from saffron. See BOTANY; FLOWERS AND INSECTS; FRUIT; GARDEN; INFLORESCENCE; SEED.

Flower Beetles, scarabeid beetles of several genera. One of the most abundant and destructive of these insects is the rose-chafer (q.v.), which annually does great damage to roses and other flowers and fruits. Several species of the genus *Euphoria*, more especially *E. inda*, is frequently found on flowers eating pollen, but it also attacks corn in the milk, and eats into various forms of fruit. Other flower beetles belonging to the genera *Hoplia* and *Trichius* are commonly found on flowers throughout the country and take some part in the cross-fertilization of useful plants. Numerous other beetles frequent flowers, among which are beautiful species of the genera *Clerus* and *Trichodes* of the *Cleridæ; Leptura* and many related genera of long-horned beetles; and many genera of small families such as the *Mordellidæ*.

Flower-bug, a very minute bug (*Triphleps insidiosus*) also called «insidious flower-bug,» and related to the bedbug. It is found on the foliage of various plants, and preys upon other minute insects.

Flower Month, in general any month in any country in which flowers are springing most abundantly; in the United States, June is specially the month of flowers. Specifically, the month Anthesterion, the eighth of the Attic year, corresponding nearly to February; so called because that time was, in that country, the season of flowers.

Flower-peckers, general name for a large family (*Dicæidæ*) of small insectivorous birds allied to the creepers (q.v.) which get their food largely by searching flowering plants and their blossoms, picking up minute insects largely by aid of a curious tongue which is separated at the end into four tubular projections. They inhabit the Indo-China region and thence throughout the archipelagoes to Australia, where the white speckled diamond-birds (*Pardalotus*) and the swallow-dicæum (*Dicæum erythrorhynchum*) are familiar friends of the gardener. They frequent bushes and trees, hopping briskly about the branches, and creeping and clinging like titmouses. Some make extremely beautiful, highly decorated nests, while others are content to deposit their eggs, which in most of the species are white, in holes in trees, or earthen banks, or old birds' nests. Some are plainly dressed, but most of the flower-peckers are gaudily colored, and several sing sweetly.

Flowering Ferns. See *Filicales* (1), under FERNS AND FERN ALLIES.

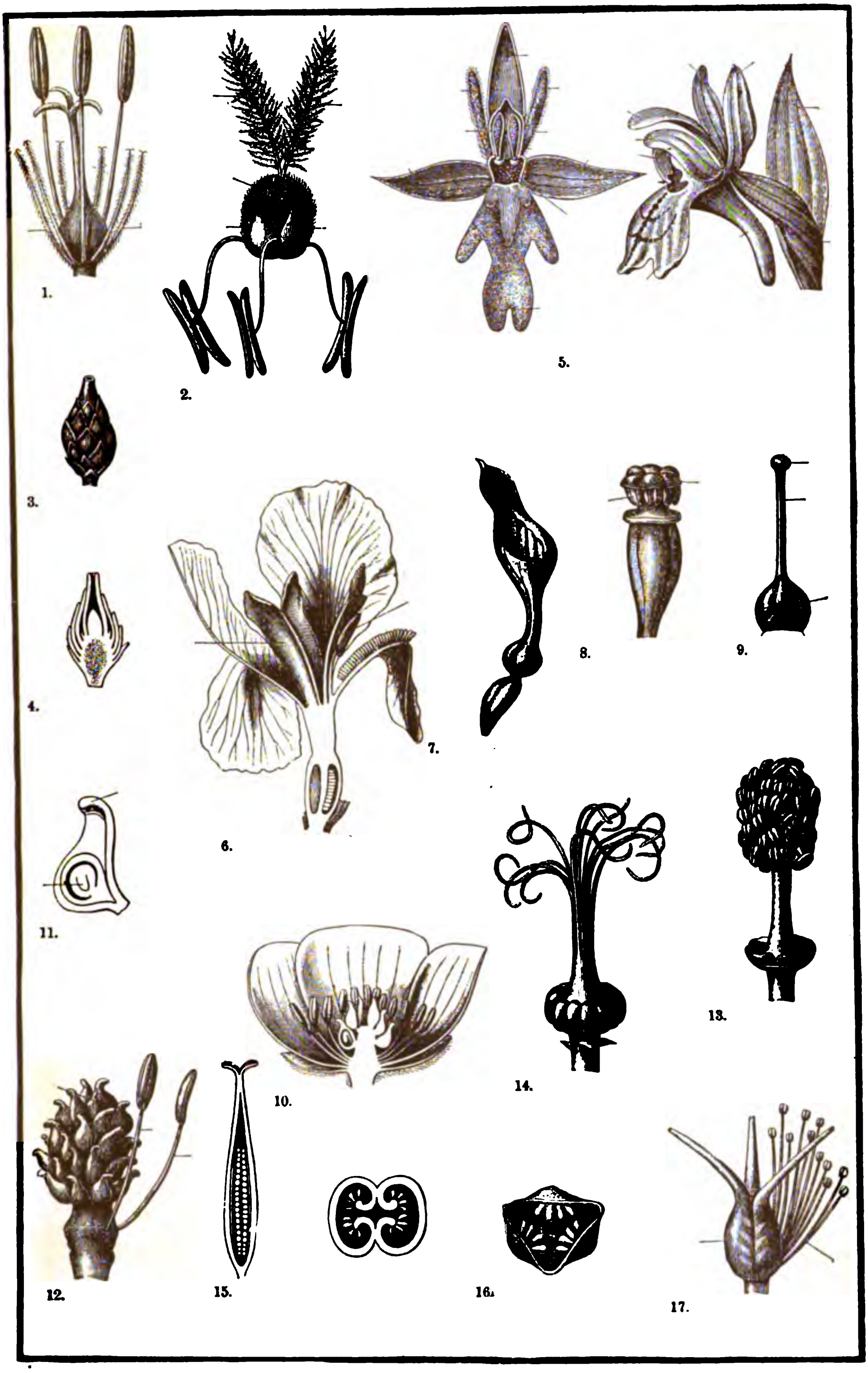
Flowers, in chemistry, a term formerly applied to a variety of substances procured by sublimation in the form of slightly cohering powder, hence in all old books we find mention made of the flowers of antimony, arsenic, zinc, and bismuth, which are the sublimed oxides of these metals in a more or less pure state. We have also still in use though not generally the terms flowers of sulphur, of benzoin, etc.

Flowers and Insects: Their Relations. In order to appreciate the intimate relations between flowers and insects we should bear in mind the fact that in all probability the earliest plants known were flowerless, and that the earliest known insects never visited flowers. The most primitive reproductive parts of plants were minute structures, simply greenish, and without colors. From the cryptogamous plants somehow arose the flowering plants, and when flowers did appear, they were of regular shape, with the corolla made up of separate petals; then finally appeared the irregular flowers like those of the monkshood, the pea, bean, wistaria, etc. The simpler forms of flowers were those of the grasses. Such plants are fertilized by the wind, but in the higher modern flowering plants the floral organs are fertilized by insects. What attracts insects to flowers, and thus causes them to carry the pollen from the stigmas to the pistil? Is it the nectar or the odor given out by the flower, or the colors of the petals?

A hawk-moth sucking nectar from a tiger-lily.

Insects Attracted by the Sweets of Flowers. — According to Darwin, Lubbock, and others, the brightly colored petals of flowers are necessary to attract bees, butterflies, moths, beetles, etc. Thus the petals of many flowers are beautifully marked with highly colored hues, which are thought to be «guiding lines,» by which the bee was guided to the nectary at the bottom of the flower. But this view has been called in question by a Belgian naturalist, Plateau. To test the matter Darwin and others had removed the petals, or corolla, and watched to see whether insects continued to visit the flower, but this, owing to want of care in removing the petals, had led to contradictory results. Plateau experimented more carefully; he avoided handling the flowers, or doing anything which might influence an insect's sense of smell. He removed the brightly colored corollas from the flowers of lobelia, ipomæa, larkspur, foxglove, etc., and in every case, except that of *Antirrhinus majus*, the mutilated flowers were observed to be freely visited by various kinds of insects (bees, bumblebees, syrphus flies, and an occasional butterfly), no special preference being exhibited for flowers that were left intact. The insects not only sucked honey from the mutilated flowers, but they often circled around them without alighting. In the case of the snapdragon, several bumblebees hovered around the mutilated heads but afterward left them for those with entire flowers, a result explained by the peculiar mode in which bees have to enter the corolla, which would render the absence of that structure perplexing to them. Plateau covered several of the large umbels of Hieracium with rhubarb leaves, when it was found that even when thus masked they were freely visited by insects. The result shows that insects are in reality guided to flowers in the great majority of cases by their sense of smell,

MORPHOLOGY OF FLOWERS.—II.



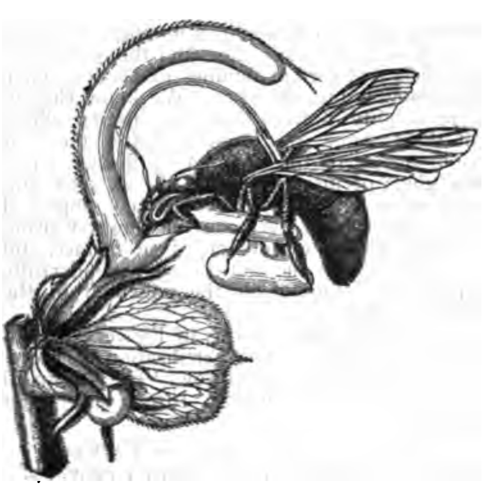
1. Hypogynous bristles of Bulrush. 2. Hypogynous scales of Grass. 3. Flower of the Yew. 4. Section of the same. 5. Perianths of Orchids. 6. Iris. 7. Aristolochia. 8. Fruit of Aristolochia, showing sessile anthers. 9. A single pistil. 10. Section of Ranunculus. 11. A single carpel of Ranunculus. 12. Gynœcium of Ranunculus. 13. Andrœcium with united filaments. 14. Gynœceum with united carpels 15. Ovary of Gentian with two united carpels. 16. Ovary of Violet with three united carpels. 17. Gynœceum of Hypericum with a part of the stamens.

the scent of the nectar attracting them. Some insects, as the white cabbage butterfly, are attracted by the white color of the flowers they visit, and yellow butterflies by yellow flowers. Undoubtedly some butterflies and moths have the color-sense, but probably those insects such as beetles, bugs, etc., which are most concerned in fertilizing flowers, are attracted by the odors emanating from the nectary and glands of such flowers.

Of flower-haunting flies (*Diptera*) the color-sense is shown in the case of certain higher types of flies which prefer red and blue flowers, and they oftener visit the more complicated kinds of flowers than do the smaller bees. These flies seem to possess greater importance for the function of pollination than previously supposed. In Africa some kinds of orchids are fertilized by flies.

It thus appears that though the colors of some flowers attract certain insects which have the sense of color, the most efficient insect-aids to fertilization of flowers are those which are attracted mainly if not solely by smelling the nectary or odor of the flower.

Plateau indeed claims that any flower is freely visited by insects if it be nectariferous, no matter how colorless or inconspicuous it may be. There are, on the other hand, flowers which seem to be wholly avoided by insects, many of which are gay and attractive enough in their shapes and colors; but when Plateau placed nectar at the base of these flowers, visits of insects were at once begun. Meehan states that in the United States a single plant of the common sumac (*Rhus glabra*) was growing in an isolated spot almost hidden by other vegetation, and far away from any flowers visited to any great extent by insects. The flowers of this shrub are small, green, entirely inconspicuous, and so far as human olfactories go, odorless. But he observed an extraordinary number of kinds of insects visiting the flowers. He infers that this remarkable collection of insects, including honey-bees and wasps, could only have been guided by the sense of smell, and he infers that all plants with nectar have odor, though it may not be strong enough to be perceptible to man.



Bee rifling a blossom.

The nectary is a specially modified scent-gland, and the nectar is a specialized form of the sap or juice of the plant. As stated by Henslow, the nectaries probably originated from the visits of insects, and the local irritation set up by these visits gradually led to the origination of the glandular secreting organ called the nectary. When the entire flower degenerates and becomes self-fertilizing, not needing the help of insects, the nectary also disappears. Ant-plants are so-called because they are due to the modifications occasioned by the visits of ants.

Fertilization of Flowers by Insects.—We have seen that insects are strongly attracted to flowers by smelling the sweets secreted by glands or nectaries. How important this nectar is to bees is proved by the fact that the honey they produce is nectar changed to honey in their digestive organs. Many insects subsist on the pollen of plants; such are bees of all kinds which use it in making bee-bread as food for their young; multitudes of wasps, flies, and beetles gather also the pollen of flowers, and eat it, this being their only food, or they store it up as nourishment for their young.

Their visits to flowers result in their carrying the pollen from one flower to another, and thus fertilizing the plant. Hence owing to the visits of honey-making bees, of wasps, of moths, and butterflies, and of pollen-eating flies and beetles, the flowers become indirectly fertilized, and were it not for their visits, such flowers would be sterile, and the species die out.

As early as 1793 Sprengel discovered the main facts and many details as to the relations between flowers and insects. As Wallace states, he noticed the curious adaptation of the structure of many flowers to the particular insects visiting them; he proved that insects cross-fertilize flowers, and that the presence of nectar and pollen ensured the continuance of their visits. Afterward it was shown that cross-fertilization of plants was a benefit to them, while Darwin (saying that «nature abhors perpetual self-fertilization») proved that this was a general occurrence not only among ordinary plants but with orchids. It thus appears that insects have been the cause of, and are the means of maintaining, the present wealth of flowers which enliven the tropical forests, and adorn our northern gardens and fields.

Colors of Flowers and the Visits of Insects.—Although it is generally claimed that sweet odors are, as Wallace says, usually supplementary to the attractions of color, yet this view, as we have seen, will have to be modified. Gaudily colored flowers, like the sunflower, poppies, and peonies, are nearly scentless compared with plants like the mignonette, which are so fragrant. White flowers are fertilized by moths, and very frequently give out their scent only at night, as in the case of the butterfly-orchis. Bright red flowers are very attractive to butterflies, and are sometimes specially adapted to be fertilized by them, as many kinds of pinks, the corn-cockle, etc. Blue flowers are especially attractive to bees and other hymenoptera, as many as 67 species having been observed to visit the common European sheep's bit. Dull yellow or brownish flowers, some of which smell like carrion, attract flies, while the dull purplish flowers of the Scrophularia attract many wasps. (Wallace.)

It is interesting to learn that many change their colors as soon as fertilized; in this way bees avoid wasting their time in visiting such flowers as have already been fertilized and their nectary exhausted. The common lung-wort is at first red, but afterward turns blue. In southern Brazil grows a species of Lantana whose flowers are yellow the first day, orange the second, and purple the third, while F. Müller observed that many butterflies visited the yellow flowers only, some both the yellow and the orange flowers, but none the purple. Moreover many flowers have been specially adapted to the kinds of insects that most abound where they grow. Thus in the Swiss lowlands the gentians, although with us they flourish in the White Mountain region, are adapted to bees, but those of the high Alps to butterflies only, as this zone is the home of Alpine butterflies. The visits of insects to flowers in fine weather are incessant and hence economy of time is, as Wallace states, very important both to the insects and the flowers, because the fine working days are comparatively few. For example, bees keep to one flower at a time, visiting hundreds of blossoms in succession; they thus acquire quickness in going at once to the nectary, and the change of color in the flower, or incipient withering when fertilized, enables them to avoid those flowers that have already had their honey exhausted.

Perforation of Flowers by Bees.— If one will watch a wistaria when in blossom, he will notice that the bumblebees, in order to get at the nectar without loss of time, perforate the corolla right over the nectary, and thus speedily rifle the flower of its sweets. So well trained is the bee that the hole is always made right opposite or over the nectary. On the other hand the honey-bee, with its shorter and weaker maxilla, cannot make a hole through the walls of the corolla, but partly enters the flower on one side or the other and with more or less trouble laps up the nectar. At the end of the season, provided bumblebees are plenty, nearly every flower on a large vine will be found to have been perforated. Similar flowers, as the clover, touch-me-not, etc., are thus perforated. Lovell states that the maxillæ alone are employed in this act, being moved slowly backward and forward in puncturing the tissue. Thus the stout strong maxillæ of the bumblebee are adapted for this purpose.

Click-beetle and orchid.

Irregular Flowers due to Visits of Insects.— It is now thought by some observers that owing to the strains, pressure, and irritation caused by the visits of insects, flowers like those of the pea, bean, etc., have been formed. Henslow points out that the lower petal or lip of these irregular flowers forms a platform on which the bee rests while engaged in probing the corolla for nectar. In the irregular flowers of the foxglove, petunia, etc., the tube of the corolla has enlarged so as to allow the ingress of an insect which partly crawls into it, hence the tubular corolla having to bear the strain upon it bulges outward, while the lip or anterior petal is not much if at all enlarged. Even if, says Henslow, no more than the head of an insect enter the flower, then the corolla shapes itself to fit it. He explains the formation of the deep tubular corolla of the evening primrose or the honeysuckle by the fact that butterflies, in probing their depths while on the wing, irritate the tube only, which is thus made to become longer and correspondingly to contract in diameter, the result being that there is but little irregularity in the shape of the flower. The immediate mechanical cause of the shape of the wing-petals of many pea-blossom-like flowers is probably due to the weight of the insect in front, the local irritations believed due to the thrust of the insect's head and its probing for nectar, united with the absence of all strains upon the sides. An example of the great thickening of the tissue just where the strain will be most felt is the flower of the lady's slipper and Calceolaria.

Origin or Modification of Insects by Flowers. — We have seen that flowers attract insects by means of their nectar and sweets and also their pollen; that the visits of insects are in favorable days practically incessant, though owing to the weather more or less intermittent; the result seems to be that the forms of insects, especially of their accessory jaws (maxillæ and labium), as well as of their legs, are wonderfully adapted to their habits. It is not improbable that by these simple mechanical causes, that is, the use or exercise of the parts concerned in gathering pollen and nectar, a number of groups of insects (bees, certain flies, and the moths and butterflies, and certain families of beetles) have been brought into existence. We know that in all probability flowers and the insects which visit them, came into existence after the coal period, owing to the reaction of flowers upon these kinds of insects, causing the exercise and modification of the structures actively employed in collecting pollen. Among the flower-visiting flies and beetles the proboscis of the former, and the maxillæ of the latter, are wonderfully adapted for scraping off the pollen from the anthers of flowers.

Consult: Darwin, 'Forms of Flowers' (London 1877); Müller, 'The Fertilization of Flowers' (London 1883); Henslow, 'The Origin of Floral Structures Through Insect and other Agencies' (New York 1893).

Alpheus S. Packard,
Late Professor of Zoology, Brown University.

Flowers, Artificial, flowers made from various materials to imitate natural blossoms. These are not a modern invention. The famous floral wreaths made by the ancient Egyptians were formed from thin plates of horn stained in different colors, sometimes also of leaves of copper, gilt or silvered over. The Romans excelled in the art of imitating flowers in wax and in this branch of the art attained a degree of perfection which has not been approached in modern times. Crassus, renowned for his wealth, gave to the victors in the games he celebrated at Rome crowns of artificial leaves made of gold and silver. In modern times the Italians were the first to acquire celebrity for the skill and taste they displayed in this manufacture, but they are now far surpassed by English and French manufactures, more especially by the latter.

The first artificial flowers made in modern times in civilized countries were manufactured out of many-colored ribbons which were twisted together and attached to small pieces of wire. But these first attempts were decidedly crude. In course of time feathers were substituted for ribbons, a more delicate material, but one to which it was not so easy to give the requisite shades of color. The plumage of the birds of South America is admirably adapted for artificial flowers on account of the brilliancy and permanence of the tints, and the natives of that continent have long practised with success the making of feather flowers. The Zoological Gardens in Regent's Park, London, contain a magnificent collection of artificial flowers made out of the feathers of humming-birds. In South America artificial flowers are also composed of the wing cases and other parts of some brilliant specimens of beetles. In Italy the cocoons of silkworms are frequently used for the purpose, as these take on a brilliant color and have a velvety appearance. Among the other materials used in this manufacture are cambric, muslin, satin, velvet, and other woven fabrics, blown glass, mother of pearl, brass, thin layers of whalebone, etc., beside the various vegetable and mineral coloring matters. Flowers were at one time made of porcelain and were perfumed. Great skill has been attained in the making of glass flowers and a remarkable collection of this kind is owned by Harvard University.

Flowers, Symbolism of, a special significance attached to flowers by means of which they are made to represent various ideas and sentiments. This mode of communicating thought has developed in certain countries into a language of remarkable elaboration. Among the Greeks and Romans the use of flowers was full of significance. Though the well-developed floral speech of the Romans was probably lost to a great extent, the study was revived in Europe during the Middle Ages, being especially appropriate in connection with such a romantic institution as chivalry. The Orientals have developed the language of flowers into a vehicle for communicating sentimental and amatory expressions of all degrees of warmth. Still further complexity is added by the habit of employing flowers the Turkish or Arabic names of which rhyme with the other really significant words. The language of flowers is, of course, arbitrary, and a bouquet which a Persian girl would understand would be unintelligible to an Egyptian inmate of the harem. Yet among European nations certain flowers have a common significance. The rose is widely accepted as the symbol of love and beauty; the forget-me-not of true love; the lily of purity; the violet of modesty; the daisy and white violet of innocence; the rosemary of remembrance; the amaranth of immortality; the asphodel of death and the unseen world; the pansy of thought; the hyacinth of sorrow; the narcissus of self-admiration; the poppy of oblivion. The almond expresses hope; the lily-of-the-valley unconscious sweetness; the wallflower, love faithful in spite of adversity; the primrose, early youth; and the cyclamen, diffidence. So surely as the orange-blossom is associated with marriage does the finding of white heather betoken good-fortune to come, while the future chances of love may be revealed from the daisy and poppy by a simple method of divination. The laurel has long been accepted as the emblem of glory, and the oak of patriotism. In the Grecian games wreaths were placed upon the brows of the victors, but these were of leaves rather than blossoms. Floral garlands were much used at the feasts of the ancients, and in India it is customary to show special honor to a guest by encircling his neck with a wreath of flowers. Historical and national associations cluster about certain flowers. The violet was the flower of Athens. The red and the white roses of Lancaster and York gave name to a great civil war. Particular families and clans have their floral badges and there are national and heraldic emblems drawn from the floral kingdom, such as the rose of England, the thistle of Scotland, the shamrock of Ireland, and the fleur-de-lis (q.v.) of France, the latter being associated for centuries with the royal crown. The pomegranate became a Spanish national emblem having previously been the emblem of Moorish Granada. In Japan, the chrysanthemum is the flower of the nation, and in India the lotus has an especially sacred significance, as it had formerly in Egypt. In the latter country it often figured in architecture. In the decorative art of India it is represented in bronze and in paintings in connection with divinities or exalted sages. The cactus is the national emblem of Mexico. No flower will ever become the national emblem of the United States in the manner in which such floral emblems have become connected with other nations, but an attempt has been made to gain an expression of popular opinion on the subject of a national flower and the golden-rod appears to lead in the contest, as it has done in the case of the Empire State, of which it has been chosen as an emblem. The legislatures of certain States have taken action on the choice of a State flower; Utah selecting the seg lily; Vermont, the red clover; Oregon, a native grape; Nebraska, the golden-rod; Michigan, the apple-blossom; Maine, the pine tassel and cone, and Iowa the wild rose. In England what may be called a party emblem is illustrated in the adoption of the primrose, generally known as Lord Beaconsfield's flower, by the Conservatives. Before the "Hundred Days" in French history, the violet was used by the adherents of Napoleon I. to symbolize the hope of his return from exile.

Floyd, John Buchanan, American statesman: b. Smithfield, Montgomery County, Va., 1 June 1807; d. near Abingdon, Va., 26 Aug. 1863. He was educated at Columbia College, S. C., graduating in 1829. Studied law and settled in southwest Virginia. Was a member of the Virginia legislature several terms, and was governor of the State 1850–3, his term being notable for his advocacy of the policy of public improvements. In 1857 he was appointed secretary of war in the cabinet of President Buchanan, and remained in it until 29 Dec. 1860, when he resigned because he considered the action of Maj. Anderson in occupying Fort Sumter a breach of faith to South Carolina. He went to Abingdon, Va. On 29 Jan., 1861 the grand jury of the District of Columbia indicted him as privy to a defalcation in the Department of the Interior. He returned to Washington, gave bail and demanded a trial, and the government thereupon, on 7 March 1861, entered a *nolle prosequi*.

After his departure he was also accused of having transferred arms from Northern to

Southern arsenals in order to arm the South for the Civil War. This charge was investigated by a Congressional committee, which, on 18 Feb. 1861, made a report showing it to be groundless, the arms transferred having been condemned arms, removed in order to make room in the Northern arsenals for modern ones.

In the summer of 1861 he was appointed a brigadier-general in the Confederate army, and raised a brigade which served in West Virginia until ordered to join the army of Gen. A. S. Johnston in the West. He was sent to Fort Donelson, arriving there after fighting had begun. When surrender was discussed, he transferred the command to Buckner and extricated his brigade; in consequence of which he was removed from command by Jefferson Davis. The State of Virginia thereupon appointed him a major-general in its service.

Floyd, William, American statesman: b. Brookhaven, Long Island, N. Y., 17 Dec. 1734; d. Weston, Oneida County, N. Y., 4 Aug. 1821. He entered political life as a delegate to the Philadelphia congress of 1774. The next year he was appointed a delegate to the first Continental Congress, and continued by successive reappointments a member of every Continental Congress up to 1782 inclusive. From 1777 to 1788 he also was a State senator under the first Constitution of New York, and in the Presidential elections of 1792, 1800, and 1804 was a Presidential elector.

Flück'iger, Friedrich August, ow'goost frēd'riH, German pharmacognosticist: b. Langenthal, Switzerland, 1828; d. 1894. He was educated at Berlin, Ban, Geneva, and Heidelberg, became president of the Swiss Association of Apothecaries in 1857, and in 1881 was member of a committee appointed to revise the pharmacopœia of the German empire. He wrote, in conjunction with Hamburg, 'Pharmacography: A History of the Principal Drugs of Vegetable Origin met with in Great Britain and British India' (1879), and works in German and French on the nature and history of drugs.

Flue. (1) A passage for the conveyance of the volatile results of combustion from the fireplace to the open air, or into another passage; a smoke duct, a chimney; one of a cluster of smoke ducts in a stack of chimneys. Also a passage in a wall for the conveyance of heat from one part of a building to another. (2) In music, one of the divisions of organ-stops, so called because the sound is produced by the wind passing through a fissure, flue, or windway, and striking against an edge above. (3) In a steam-engine, a pipe for the conveyance of the caloric current through a boiler, to heat the surrounding water. It is usually secured in the sheets of the fire box and smoke box respectively, as in the locomotive.

Fluel'len, a humorous character in Shakespeare's play 'Henry the Fifth.' He is a disputatious little soldier, pugnacious, and as voluble as his Welsh accent permits him to be when attempting to speak English.

Flü'gel, Johann Gottfried, yō'hăn gōt'frēd, German lexicographer: b. Barby on the Elbe 22 Nov. 1788; d. Leipsic 24 June 1855. He spent many years in the United States prior to 1820 in business, diplomatic and official occupations, and became professor of English in the University of Leipsic in 1824. He compiled a 'Complete English-German and German-English Dictionary' (1830), besides publishing 'A Series of Commercial Letters' (9th ed. 1874); 'Practical Handbook of English Business Correspondence' (9th ed. 1873); 'Triglot; or Mercantile Dictionary in Three Tongues — German, English, French' (2d ed. 1854); and other useful manuals, all revised, or brought down to contemporary needs, by his son.

Flügel, Otto, German philosopher: b. Lützen 1842. He studied at Schulpforta and Halle, and took up pastoral work; was made editor of the 'Zeitschrift für exacte Philosophie im Sinne des Neueren Philosophischen Realismus,' and in 1894 was one of the founders of 'Zeitschrift für Philosophie und Pädagogik.' He supports Herbartian realism, as opposed to New-Kantian speculations, yet he believes in the necessity of a revelation. Among his works may be mentioned: 'Die Spekulative Theologie der Gegenwart'; 'Das Ich und die sittliche Idee im Leben der Völker' (1892); 'Über die persönliche Unsterblichkeit' (1902).

Flüg'gen, Gis'bert, German painter: b. at Cologne 9 Feb. 1811; d. Munich 3 Sept. 1859. In his youth he learned the manufacture of novelties in his native town, and in 1833 began his art studies at Munich, which he made his permanent home. He is a German counterpart of Hogarth and Wilkie, whom he rivals in masterly grouping and life-like expression, while in the technique of the brush he excels them both.

Fluid, a substance devoid of rigidity, or whose modulus of rigidity (see ELASTICITY) is zero. The word includes both gases and liquids, since these bodies, while resisting compression, offer no sensible resistance to change of form, but yield continuously and without limit to any force which tends to alter their shape while leaving their volume constant. The word "fluid" is also figuratively applied to other things which may be conveniently represented to the mind as fluids, even though it is known that they are not such. We speak, for example, of the "electric fluid," thereby meaning electricity, whose motions and general properties are known to conform to certain differential equations that are strongly suggestive of those governing the motions and properties of true fluids. This figurative use of the word is now avoided by the best writers, because, while it is convenient from certain points of view, it connotes properties that the things that it stands for do not possess. It dates from the time when electricity, magnetism, nervous energy, and certain other obscure manifestations of nature were actually believed to be due to imponderable fluids that were supposed to have a real, objective existence. See CRITICAL POINT; ELASTICITY; GAS; GASES, KINETIC THEORY OF; LIQUID; MATTER; THERMODYNAMICS; etc.

Fluid Lens, in optics, a lens in which a liquid is imprisoned between circular glass disks of the required curvatures. Attempts to obtain achromatism have been made by using metallic solutions and other liquids having a higher dispersive power than flint glass.

Fluke, or Pole Flounder, a fish, one of the smaller deep-water flounders (*Glyptocephalus cynoglossus*), common near both coasts of the North Atlantic, caught by means of beam-trawls in great quantities, and highly prized as food, especially in Great Britain, where it is considered little inferior to the sole. It is the «craig fluke» of Scotland. See Flounder.

Fluke-worm. See Distoma; Trematodea.

Flume (Latin *flumen*, stream), an artificial channel or conduit used to convey water for power development, hydraulic mining and irrigation. Flumes are commonly built of wood, but may be of steel and are placed above ground, frequently over trestles. See Irrigation; Logging; Mining.

Flu'or-spar. See Fluorite.

Fluores'cence, that property of certain bodies in virtue of which they become self-luminous when exposed to light of certain wave-lengths. All bodies reflect a part of the incident light, but fluorescence is more than a mere reflection, as may best be shown by an example. «Canary glass» (glass colored slightly with oxid of uranium) exhibits a beautiful yellowish-green surface color when well illuminated, and for this reason it is much used for the production of ornamental effects. If a ray of sunlight be admitted into a darkened room through a piece of cobalt glass that is so dense that the feeble violet light that it transmits is barely visible, the canary glass shows its yellow-green color brilliantly when placed in its path. This shows that the phenomenon is not simple reflection, and further evidence of the same sort may easily be had. Glass that is tinged brownish-yellow by oxid of gold is almost perfectly transparent to the golden light from the canary glass, but if the violet light from the cobalt glass is caused to traverse the gold-oxid glass before striking the canary glass, the fluorescence is no longer observed. Furthermore, light that has passed through one piece of canary glass is incapable of exciting fluorescence in a second piece. These and other equally remarkable phenomena indicate that a fluorescent substance absorbs a portion of the light that strikes it, modifies it profoundly in some manner, and then radiates it again. Stokes has shown that the modification consists in increasing the wave-length of the incident light; and it is now known that fluorescent light invariably has a greater wave-length than the primary light that excites the fluorescence. This fact has an important bearing upon many of the phenomena of physics. When it had been determined, for example, that the «X-rays» differ from ordinary light merely by having a very different wave-length, the question whether their wave-length is longer or shorter was immediately answered by the fact they can excite brilliant fluorescence. Knowing that the X-rays are either too long or too short to affect the eye, and knowing also that fluorescent light always has a longer wave-length than the light that excites it, it follows at once that the X-rays have a shorter wave-length than ordinary light.

Many substances exhibit fluorescence to a greater or lesser degree. An aqueous infusion of horse-chestnut bark shows it brilliantly, and so also does a solution of sulphate of quinine. Certain of the coal-tar colors (q.v.) are conspicuously fluorescent, fluorescein taking its name from this fact. Kerosene is fluorescent, and sometimes strongly so. Most fluorescent substances cease to emit light almost instantaneously when the incident light is cut off from them. Some, however, such as calcium tungstate and the sulphids of calcium, barium, and strontium, continue to emit their rays for a sensible time, fading gradually away into darkness after the incident light ceases to excite them. Instruments consisting of screens that are coated with some fluorescent material and protected from ordinary light by shields, or by enclosure within a light-tight box, are known as «fluoroscopes,» and are used for studying the X-rays (or Röntgen rays), and the shadows cast by them. It is to be observed that fluorescence differs from phosphorescence (q.v.) not only because it is usually of very short duration, but primarily because it is induced by the exciting action of light-rays. Phosphorescence may be due to very different causes. The light emitted by phosphorus, for example, is probably due to the slow oxidation of that substance. That which is observed in the ocean at night, and in connection with various fungi and insects, is due to causes which are more or less obscure; but in any event these various phosphorescent phenomena are quite different from true fluorescence. The name «fluorescence» was coined by Sir George G. Stokes in 1852, from the fact that the mineral fluorite sometimes exhibits the phenomenon. Previous to 1852 fluorescence was known as «epipolic dispersion.» Consult: Tait, ‘Light’; Preston, ‘The Theory of Light.’

Flu'orides. See Fluorine.

Flu'orine, a gaseous, non-metallic element, possessing properties resembling those of chlorine, and exhibiting powerful chemical affinity. It occurs abundantly in nature, notably in the minerals fluorite and cryolite, from the former of which it takes its name. The elementary character of fluorine was first recognized by Ampère and Davy about 1810; but although many attempts were made to isolate it, none was certainly successful until 1887, when Moissan succeeded in preparing it in the elementary state by electrolyzing a solution of hydrogen potassium fluoride, HF.KF, in perfectly anhydrous hydrofluoric acid, the solution being contained in a platinum vessel whose temperature was maintained at 10° F. below zero, and the electrolysis conducted by means of 20 Bunsen elements connected in series. When thus prepared fluorine is a gas, variously described as colorless, or as of a light greenish-yellow color. Many of the elements take fire when immersed in it, and burn with the formation of the corresponding fluorides. Water is decomposed by it, with the formation of hydrofluoric acid, HF, and the liberation of ozonized oxygen; and in fact fluorine appears to combine with all known elements except oxygen and carbon, and argon, helium, and the other recently discovered inert gases of the atmosphere. Fluorine has the chemical symbol F, is a monad, and has an atomic weight of about 19. Few of the physical properties of the element are yet known, on account of the difficulty of handling it. It corrodes glass rapidly, for example, and for this reason glass vessels cannot be used in experimenting with it.

Fluorine combines with hydrogen directly even in the dark, the compound, HF, that is formed being known as hydrofluoric acid. Hydrofluoric acid is more conveniently prepared by means of the action of strong sulphuric acid upon the mineral fluorite (calcium fluoride, CaF_2). The reaction is as follows: $H_2SO_4 + CaF_2 = 2HF + CaSO_4$. Hydrofluoric acid is a colorless gas at ordinary temperatures and pressures, fuming strongly in the air. It condenses at 5° F. below zero to a colorless, mobile liquid having a specific gravity of about 0.988, and boiling, at ordinary atmospheric pressure, at 67° F. As thus prepared, liquid hydrofluoric acid contains traces of water; but these may be removed by electrolysis, the liberated fluorine combining with the water as noted above, and the oxygen of the water escaping in the free state. When the water has all been eliminated, electrolysis ceases. The commercial importance of hydrofluoric acid depends upon the fact that this substance attacks glass so freely that it must be prepared and stored in vessels of lead or rubber. It is much used for etching upon glass, the reaction between the glass and the acid being $4HF + SiO_2 = 2H_2O + SiF_4$; the acid attacking the silica of the glass, with the formation of water and a gaseous compound of silicon, known as silicon tetrafluoride. When silicon tetrafluoride is passed into water, it is decomposed according to the equation $3SiF_4 + 4H_2O = 2H_2SiF_6 + H_4SiO_4$; the substance represented by the last term in this equation, silicic acid, separates out as an insoluble precipitate, while the compound H_2SiF_6, known as hydro-fluo-silicic acid, remains in solution. Hydro-fluo-silicic acid forms salts which are known as silico-fluorides. Potassium silico-fluoride, K_2SiF_6, is one of the few potassium compounds that are insoluble in water.

Liquid anhydrous hydrofluoric acid does not attack glass, but the action is vigorous when traces of water are present. The diluted acid is therefore used in practical etching, the article that is to be treated being immersed in it, after the parts that are not to be attacked have been protected by a coating of wax, or of a special "etching varnish." Hydrofluoric acid in aqueous solution acts very similarly to hydrochloric acid, forming salts which are known as fluorides; hydrogen being liberated when the acid acts upon a metal, and water when upon an oxid.

Fluorite, or **Fluor Spar,** a native fluoride of calcium having the formula CaF_2, crystallizing in the isometric system with cubical habit, and also occurring massive. It has a hardness of 4 and a specific gravity varying from 3.00 to 3.25. It has a vitreous lustre, and is transparent to subtranslucent, varying in color from white through yellow, green, red, blue, and brown. The green and violet-blue varieties are most common, and the red is rare. Certain specimens exhibit a bluish fluorescence (q.v.), and the mineral develops differences of electrical potential under the influence of heat and of light. Fluorite occurs in England, Germany, and many parts of the United States, and the commercial supply comes chiefly from Kentucky, Illinois, Arizona, Tennessee, and New Hampshire. It is a chief source of fluorine and hydrofluoric acid (see FLUORINE), and is also used as a flux for promoting the fusion of certain refractory minerals, deriving its name from this latter circumstance (Latin, *fluor*, a flow). Colorless specimens have been used for the manufacture of lenses, for which they are well adapted on account of their small dispersion.

Fluor'oscope. See FLUORESCENCE.

Flürsheim, Michael, mēH'ā-el flürs'hīm, German social reformer: b. Frankfort-on-Main 24 Jan. 1844. He emigrated to the United States in 1867, and resided there for five years. He then returned to Europe and established an iron foundry in Gaggenau, Baden (1888). Since 1892 he has lived at Castagnola, near Lugano, Switzerland, engaged in disseminating his ideas through his writings. He believes private property is the cause of immense wealth to some and profound poverty to others, and advocates the government possession of land. His works are: 'Auf friedlichem Wege' (1884); 'Deutschland in 100 Jahren' (1894); 'Papst und Sozialreform' (1891); 'Der Einzige Rettungsweg' (1894); 'Rent, Interest, and Wages' (1891).

Flush'ing, Netherlands, a flourishing seaport town in the province of Zeeland, on the south coast of the island of Walcheren, at the mouth of the West Schelde. It has long been a place of importance, but has few buildings or institutions of note. The town-house is a roomy, suitable edifice; the exchange is a simple building, and near it is a statue, erected in 1841, of Admiral van Ruyter, born in Flushing in 1607. The inhabitants are chiefly engaged in commerce, for the encouragement of which much has been done in recent times by the construction of docks, etc. Flushing has suffered several times from fire, water, and war, and in 1809 was bombarded by a British fleet, under Lord Chatham.

Flushing, N. Y., a former village on Long Island, now a part of the borough of Queens, New York. It was settled in 1645 and was called Vlissingen.

Flute, a musical wind instrument, consisting of a tube furnished with a number of holes in it for the purpose of varying its sounds. The oldest form of the English flute had seven holes which could be stopped by the fingers, but it had no finger-keys. This was in use till about the beginning of the 18th century, when it gave place to the German flute, an instrument which, in its best form, was 27 inches in length, consisted of 4 pieces fitting into one another, and had 6 finger-holes for the normal tones, and from 6 to 12 keys for the semitones, with a compass of nearly 3 octaves, counting from middle C upward, the higher octaves being obtained by overblowing. The improvements made on this instrument, by Böhm, a German, acting in conjunction with Gordon, an Englishman, enable the player to perform music on any key, with all the chromatic intervals. The chief improvement consisted in the application of a system of keys, by which several holes could be stopped at one time, by one movement of the finger. The flutes made by Böhm are now taken as the models by most makers in all countries. In modern flutes the number of keys varies. The materials of which flutes are made are box, ivory, ebony, silver, glass, and a kind of red ebony.

Fluted Scale. See SCALE INSECTS.

Fluting, in architecture, channels or furrows cut perpendicularly in the shafts of columns, particularly Doric, Ionic, and Corinthian

It seems probable that this kind of ornament had some relation to the original type; perhaps the furrowed trunk might have suggested the idea. It is, however, a beautiful ornament, which is applied with equal happiness to break the otherwise heavy mass of a Doric shaft, or to obviate an inconsistent plainness in the other orders. When the lower parts of the flutes of a column are filled with a convex bead, they are said to be cabled. See ARCHITECTURE.

Fluting Machine, a machine for corrugating or crimping metals. It has a pair of rollers, each one having projections which enter the interdental spaces of the other. By turning the operating screw the bent bar, and with it the upper roller, can be adjusted up or down at will to regulate the distance between the two rollers.

Flux, a substance or mixture added to assist the fusion of minerals. In the large way, limestone, and fluor-spar are used as fluxes. In the smelting of iron great attention has to be paid to the fluxes, because on their character depends to some extent the complete separation of the metal. To accomplish this the flux must be such that it will combine with the earthy matter of the ore, and form a slag, which must neither be too refractory nor fusible. Hence if the ore abound in clay or sulphur, lime, or limestone, and possibly sand, must be added; if in quartz, lime and clay are requisite, otherwise the quartz is slagged by combining with part of the iron, which is thus lost. Frequently ores are so selected that the earthy matters present may flux each other, but this requires skill and experience. The fluxes used in pottery are very various, and are distinguished by different names; but they almost all consist of litharge or red-lead, with sand or boracic acid, sometimes singly, sometimes together. They are, therefore, essentially colorless glasses used as vehicles for infusible colors. See COPPER; IRON; etc.

Fluxion, fluk'shôn, (1) in medicine, an unnatural flow or determination of blood or other humor toward any organ; a catarrh. (2) In mathematics, a method of calculation resulting from the operation of fluents, or flowing numbers. Thus a mathematical line may be considered as produced by the fluxion or flowing of a point; a surface by the fluxion of a line, and a solid by the fluxion of a surface. A mathematical point in motion will really make a line; a revolving radius which is a line will make a circle which is a surface, and its revolution about its diameter will generate a sphere which is a solid. The same principle may be applied to purely numerical calculations, like the formulæ of algebra. This branch of the higher mathematics was invented by Newton in 1665. In 1676 he communicated his method to Oldenburg in a sentence with all the letters disarranged so that his correspondent could not possibly have put them in order. If he had succeeded in doing this the sentence would have been *Data æquatione quotcunque fluentes quantitates involvente fluxiones invenire et vice versa.* [«Given it makes no matter how many equations involving fluent quantities, fluxions are to be discovered, and the reverse is true» (that is, where fluxions occur the fluents are to be found).] Leibnitz received this letter in 1677, and in 1684 explained a discovery which he had made. It was that of the differential calculus, which was essentially the same as that of fluxions. What Newton called fluxions, Leibnitz called differences. An angry controversy subsequently arose between Newton and Leibnitz as to the priority of discovery, the Royal Society of London taking the part of the former, who was then its president, and the scientific men of Germany that of the latter, who was their countryman. Both appear to have made the discovery independently. In the slight differences of method which exist, the advantage lay with Leibnitz, and while the term fluxions is now scarcely ever used, that of differential calculus is in common use. The first elementary treatise on fluxions published in England was by John Harris in 1702. A description of the process by Newton himself followed in 1704, in his 'Quadrature of Curves.' See CALCULATION; MATHEMATICS.

Fly, an insect. See DIPTERA; FLIES; and the names of various groups and species of flies.

Fly-blister, a collection of blood-serum between the layers of the skin, caused by the application of some preparation of the Spanish fly. It is used to extract fluid from underlying tissues, and to cause desired changes in local circulation. Absorption from applications sometimes takes place, giving rise to the irritation and inflammation of the kidneys, bladder and genital organs which characterize the drug when taken internally.

Fly-casting, the art of throwing an artificial fly in angling. (For the various methods employed see ANGLING.) Aside from its use in actual fishing the art is employed by some in competitive contests, and «national tournaments» are held annually in both Great Britain and the United States, sustained by a federation of clubs devoted to the sport, in which the championship and prizes are competed for.

Fly River, a considerable stream in New Guinea (British) which has its source in the Victor Emanuel Mountains and empties into the Gulf of Papua. Its length is 150 miles. There is a delta at the mouth of Fly River in which lies the island of Kiwai.

Fly Sheet, a paper broadside or bill. Certain publications of this sort advocating changes in the English Wesleyan Methodist constitution and practice were published in 1847-8. Those who were suspected of having them issued were expelled in 1849, and taking the name of Methodist Reformers laid the foundation of a new denomination, which has, however, since been amalgamated with others, the designation of the collective body being the United Free Church Methodists.

Fly, Spanish. See BLISTER BEETLE.

Fly-up-the-Creek, a local name for the little green heron (*Ardea virescens*), a common bird throughout eastern North America. See HERON.

Flycatcher, popularly and broadly used, birds which catch insects in the air. More restrictedly, in ornithology, birds of the Old World insectivorous family *Muscicapidæ*, allied to the thrushes; but this is a group very difficult to limit or define. All these are small, active birds, with great activity in flight and skill in seizing their agile prey; and all have broad flattened beaks, at the base of which is a growth of long stiff rictal bristles. The feet are usually weak and the wings long and pointed. Four or five species are common summer visitors to Europe, including the familiar and typical spotted flycatcher (*Muscicapa grisola*) and the pied or blackcap (*M. atricapilla*). In all the hotter latitudes of the Old World the species are very numerous, and ornate, many being crested, or having, in the case of the males at least, very long tail-feathers, which are handled most gracefully. Such are the paradise flycatchers (genus *Tersiphone*) of India and eastward, the Japanese species of which is so commonly represented on painted or embroidered screens. The «fantail» (q.v.) is another species remarkable in its flight. Most of these flycatchers are birds of the woods, and are usually solitary and silent, feeding on little except insects, which are habitually caught upon the wing with an audible snap of the bill. Some of the smaller ones are sometimes called «flysnappers» (q.v.). They nest in various situations, and many make highly beautiful receptacles for their variously decorated eggs.

None of the muscicapids is to be found in the New World, but America has a large family of flycatchers (the *Tyrannidæ*) just as suitably so-called as are the others, so far as habits are concerned; nor are they far removed in structure. This family contains some 400 species, mainly tropical, and chiefly of an olive-green, or black-and-gray complexion, often with ornamental touches of scarlet on the head or wings. The bill is rather stronger as a rule than in the Old World flycatchers, and often decidedly hooked, like that of vireos or shrikes. The wings are usually short, and the tail varies greatly, sometimes being beautifully prolonged, as in the scissor-tailed flycatcher of the western United States. The genus *Alectrurus* presents still more striking examples of very long and beautifully modified tail plumes. Good examples of this group are the king-birds, pipiris, pewees, vermilion flycatcher, and scissor-tail, elsewhere described. An excellent general account of these families will be found in Evans' 'Birds' (1900).

Ernest Ingersoll.

Flying Bridge. See Bridge; Movable Bridges.

Flying Buttress, a contrivance by means of which the thrust of a vault or arch is carried across an open space to a buttress (q.v.). Nearly every instance of the use of the flying buttress is in connection with Gothic architecture, and some of the earliest forms are very curious and illustrate well the growth of the style. The «high vault» over the nave or choir should have a buttress on each side to resist its thrust, but to build one there would be to obstruct the aisle on either side, which it was important to leave open and free as a part of the great interior of the church. The buttress, therefore, was built outside of the aisle, where it took up the thrust of the aisle vault and was made much larger than necessary for that purpose so as to receive also the thrust of the high vault, which was transmitted to it by means of a sloping bar of stone carried on a separate arch or half-arch. This bar and half-arch taken together form the flying buttress. In large churches the flying buttress is sometimes double or two-fold, leaping over two aisles, or an aisle and a row of chapels; and again it is sometimes repeated in height, one flying buttress coming above another — these being sometimes an addition where a slight yielding was visible.

Flying Dragon, a flying lizard (q.v.) of the Oriental genus *Draco*.

Flying Dutchman, a phantom ship said to be seen in stormy weather off the Cape of Good Hope, and thought to forebode ill luck. One form of the legend has it that the ship is doomed never to enter a port on account of a murder committed on board; another, that the captain, a Dutchman, swore a profane oath that he would weather the Cape though he should beat there till the last day. He was taken at his word, and there he still beats, but never suceeds in rounding the point. He sometimes hails vessels and requests them to take letters home from him. The legend is supposed to have originated in the sight of some ship reflected from the clouds. It has been made the groundwork of one or two novels and of Wagner's opera 'Der Fliegende Holländer.'

Flying-fish, a fish able to leave the water when alarmed or pursued, and sustain itself for several seconds in the air. In tropical seas the flying-fish rise from the water in flocks, or, more properly, shoals, of many thousands at a time, when disturbed by the passing of a ship, or pursued by such foes as the bluefish and albicore. They spring from the crest of a wave, and, darting forward, plunge into another to wet the membrane of the fins, and in this manner continue their flights for several hundred yards, often pursued by marine birds in the element to which they are driven for protection against the tyrants of their own. The sole motive power is the propulsion obtained by the work of the tail in giving the rushing leap from the water; but the great pectorals act to some extent as parachutes. In all the species belonging to the genus *Exocœtus* (which is typical of the family *Exocœtidæ*, allied to the sauries), the pectoral fins are very much developed, and the superior lobe of the caudal fin shorter; the head and body are invested with large soft scales, and the body has a ridge or carina extending longitudinally along each flank, which gives it somewhat of an angular appearance. Head, when viewed from the front, triangular; eyes very large; air-bladder very large. Flying-fish are inhabitants of every temperate sea, though abounding in the vicinity of the equator. In length they rarely exceed 13 inches, and are commonly found about 8. The flesh is pleasant. Several species are described by naturalists, some of which have very long fleshy filaments depending from the lower jaw, the use of which is not known. The *Exocœtus volitans*, or common flying-fish of the Atlantic, is also known in Pacific waters; and the coast of California is visited by a large species, 18 inches long (*E. californicus*) called *volador* by the Spanish fishermen. About 65 species are contained in this and other genera, among which is *Fodiator*, with at least one common flying-fish (*F. acus*), distinguished by sharpness of its snout. Another sort of flying-fish is the gurnard or sea-robin (qq.v.).

Flying-fox, or Fox-bat, one of the great fruit-bats (q.v.) of the Oriental region; specifically the kalong (*Pteropus edulis*), which is regarded as good food by the people of Java and neighboring islands. It is the largest of known bats, measuring five feet in expanse of wings, has rusty red fur, woolly upon the neck, and a long pointed fox-like muzzle, short, triangular ears, and large eyes. These bats belong to a very large widespread genus, and have the general characteristics and habits of the fruit-bats (q.v.).

Flying Frog, a Malayan tree-dwelling frog of the genus *Rhacophorus,* which has large webbed feet with adhesive disks. Some 20 species are known in various parts of the tropics, one of which was believed by Wallace to sail down from trees in a long slanting flight; but there is no direct evidence of it as to any species. A full account of the varied habits of the genus will be found in Gadow's 'Amphibia and Reptiles' (1901).

Flying Gecko. See Flying-lizard.

Flying Gurnard, or Robin. See Flying-fish.

Flying-lemur. See Colugo.

Flying Lizards. Various lizards are provided with something more or less elaborate in the way of a parachute assisting them in springing from branch to branch, and perhaps in frightening off would-be enemies. Thus a Malayan gecko (*Ptychozoon homalocephalon*), about eight inches long, with membranous expansions along the sides of the neck, body, tail and limbs, which are supposed to enable it to make long, sliding leaps; but its habits are very little known. The term applies especially, however, to the East Indian "flying-dragons" or showy lizards of the genus *Draco,* which have loose folds of skin distensible by the erection of several movable ribs, and spread as a parachute. There are various species, harmless, pretty and tamable.

Flying Machine, a device for enabling man to navigate the air. The feat of flying has been often attempted; even among the ancients it was tried, and we are informed, succeeded to some slight extent. Friar Bacon affirms in his writings that this feat is not only possible, but he also informs us that he himself knew how to construct a machine in which a man, in a sitting position, might be able to transport himself through the air like one of the feathered tribe. The secret of Friar Bacon consisted of a very simple mechanical contrivance: It was a pair of globes made of hollow copper, exhausted of air, on which a chair could be supported, by which means a man could float in the atmosphere above the earth, and could buoy himself along. Another friar asserts the truth of this invention, or, at least, of one similar. Father Francisco Lana declares that a round vessel of plate-brass, 14 feet in diameter, weighing 3 ounces per square foot, will only weigh 1,848 ounces; whereas a quantity of common air of the same bulk will weigh 2,155 2-3 ounces; consequently he deduces the fact that the globe will not only be sustained in the air, but that it will be capable of supporting a weight of 373 2-3 ounces; and also that a globe of the same weight, but greater in capacity, would support a man. This, however, is a fallacy; for, from the fact of nature abhorring a vacuum, the globe would be crushed in by the superior force of the atmosphere. At many periods this subject has been taken up by philosophers, particularly in the reign of Charles II. For modern inventions under this heading see Aërial Locomotion; Aerodrome; Aeroplane; Balloons; Langley, S. P.; Santos-Dumont.

Flying Mouse. See Phalanger.

Flying Phalanger. See Phalanger.

Flying-squid, a squid of the genus *Ommastrephes,* having two large lateral fins, which enable it to leap so high out of the water that sometimes these mollusks fall on ships' decks. See Squid.

Flying Squirrel, a small squirrel with soft, dense fur; the skin on the sides capable of being drawn out by extending the legs, so as to form a "parachute," like that of the bat. There are various species native to America, Europe, and Asia, all falling within two genera, *Pteromys,* and *Sciuropterus.* In the latter genus are the European and American flying squirrels. The American species (*S. volucella*) is found from Maine to Florida and westward to the plains. It is entirely nocturnal in habits, and so closely resembles, in color, the bark of the dead trees wherein it makes its home that it is well-nigh invisible. Hence, less is known of it than of other squirrels. Yet when caught it proves to be a gentle, soft-eyed little creature easily tamed. All flying squirrels live in the woods, and gnaw into decayed tree-trunks, where such are obtainable, to make their nests. They feed on nuts, leaf-buds; and, sometimes, on birds' eggs, and even on small birds. Their sailing flight may extend as far as 60 feet, and they cover this distance with a rapid, graceful motion. Wherever found, flying squirrels seem to be fairly numerous, except in Alaska, where one species is found, but is very rare.

Flynt, Josiah. See Willard, Josiah Flynt.

Flysnapper, a remarkable bird (*Phænopepla nitens*) of the southwestern United States, which belongs to the wax-wing family (*Ampelidæ*), but has the shy yet active movements of a flycatcher with a habit of jerking its tail. The male is shining bluish-black, with white wing-quills and vent, and a noble crest; his mate is gray, brown and white. It catches insects on the wing, by leaping from its perch and snapping at them noisily; but also eats mistletoe berries, etc. It makes a shallow nest in a low tree and lays eggs with dark dots about the small end. The term "flysnapper" is also given to some of the smaller flycatchers (q.v.).

Fly-wheel, a wheel employed in machinery, which by means of its great momentum renders equable and regular the motion which is generated by an irregular or intermittent force, or meets with an irregular or intermittent resistance. In order to effect this object its rim is made heavy, its circumference proportionately long, and it is hung on the revolving shaft of the machine it controls. Thus by its inertia it opposes any sudden acceleration of speed, and by its accumulated momentum it prevents sudden diminution of speed; acting in the latter case as a store of power to continue the movement when the motor temporarily flags, or in passing dead centres when the motor is inoperative.

Fo, the name given by the Chinese to Buddha. Originally, the name Buddha was expressed in the Chinese language with sufficient exactness by the term *Fô-thau,* pronounced *Fôudah;* but, as is usual in China with proper names, the last syllable was subsequently dropped. See BUDDHISM.

Foa, Eugénie, é-jä-nē föä, French author: b. Bordeaux 1708; d. 1853. Her maiden name was Fradis, and she was of Spanish-Jewish descent. Separated from her husband she supported herself by her pen, often writing under the name "MARIA FITZCLARENCE." Her tales for young children are delightfully clever. Notable among her works are: 'Les Mémoires d'un Polichinelle' (1839); 'Le Petit Robinson de Paris' (1840); and 'Le Vieux Paris' (1840).

Focus, a word introduced into science by Kepler in 1604. It literally means a hearth, round which all the members of a family gather, and takes the acquired meaning of the centre, into which certain activities are gathered. In optics it denotes the point at which divergent rays of light are brought to meet again, and from which they appear to proceed. The principal focus of a lens is the focus of rays falling upon the lens in a line parallel to its axis. The conjugate foci of a mirror or lens are two points so situated that the rays emitted from a light, or a luminous object, at either point, are reflected or refracted to the other. In photography the word is familiarly used of the image reflected on the screen of ground glass, which is said to be in focus when it is fixed at a true focal point, and so as to procure a focal or undistorted effect. It is also used of the lens, with regard to its distance from the screen of ground glass. The lens is in focus when it transmits to the screen an image without blurring or aberration. See LENS; LIGHT; MIRROR; OPTICS.

The term is employed in **geometry** in the description of the ellipse, which has two foci, of which it can be proved that the sum of the distances of any point of an ellipse from its foci is constant, and the difference of the distances of any point of a hyperbole from its foci is constant.

Fodder (A. S. *fódor*, cog. with Ger. *futter*), the food collected by man for the use of the domestic herbivorous quadrupeds. In English the term is commonly restricted to dried herbage, as hay and straw; but in other languages it is more comprehensive, and includes all the food of cattle, except what they gather for themselves in the field. The principal part of the food of the domestic herbivora is furnished by grasses, most of which are eaten by them when fresh and green. Besides the supplies which they receive of the surplus of corn cultivated for human food, they are also, to a considerable extent, dependent on the straw or dried herbage of the corn-plants for their winter provender; and that of many other grasses, cultivated on this account alone, is converted into hay for their use. Hay, being cut and rapidly dried while the plant is still full of sap, contains more nutritious matter than the ripened straw of the cereals. In the United States the best grasses are timothy, red top or Rhode Island bent, white top, orchard grass, and June grass or Kentucky blue grass. In California the best fodder grass is the alfalfa, of which three or even four crops a year are obtained.

Next to the grasses are ranked the *Leguminosæ,* affording food for cattle in their seeds — as beans, peas, lentils, lupines, etc. — and in their herbage, on account of which many of them are cultivated, as clover, lucerne, vetch, tares, sainfoin, etc. When consumed green, the produce of these crops is usually termed forage or green forage. (See SILAGE.) Some of them enter also largely into the composition of hay, being cut and dried with the grasses along with which they have been sown. Some of the *Cruciferæ* are cultivated to a considerable extent as forage-plants, cattle being fed on their green herbage, although they are not suitable for drying as fodder. Among these are kale and cabbage, rape, etc. In some parts of the world cattle are not unfrequently fed on the leaves of trees, as in the Himalayas, where the leaves of different species of Aralia, Grewia, elm, and oak are chiefly employed for this purpose, and are collected, dried, and stacked for winter fodder. In seasons of drought in India cattle are kept alive on the green leaves and pods of acacia and *Inga dulcis.* See ALFALFA; CLOVER; GRASSES; HAY; PASTURE; etc.

Fodder, Green. See SILAGE.

Fodientia, the aard-varks (q.v.); also EDENTATA.

Fœniculum. See FENNEL.

Foehn (fēn) **Wind,** a warm wind that blows from the Alps in some of the northern valleys of Switzerland. At one time the *fœhn* was supposed to be an air-current that had been warmed by passing over the Desert of Sahara. Now it is known that the *fœhn* is warm because it is a south wind which, robbed of its moisture by expansion and cooling in passing over the Alps is warmed by compression in descending through the increase of atmospheric pressure with decreased altitude. It corresponds to the Chinook wind of Montana, Washington, and British Columbia. See CHINOOK WIND.

Fœtus, fē'tus, **Development of,** the growth of the unborn child from the fourth month until its birth. The convolutions of the brain, distinguishable organs of sex, ossification, and muscular movement advance in the fifth month, during which nails and hair appear. During the sixth month the pubic bones ossify, eyelids and eyelashes form, fat develops under the skin. In the seventh month, the fat increases, the eyelids are open. During the eighth month the nails are fully developed, and the fœtus attains a weight of from 5 to 9 pounds. See also EMBRYO.

Fog, a very thick mist; small hollow vesicles of water suspended in the air, but so low as to be but a short distance from the earth in place of rising high above it and becoming so illuminated by the sun as to constitute clouds of varied hue. Fogs often arise when the air above warm, moist soil is colder than the soil itself. The hot vapors from the ground are then condensed by coming in contact with the colder air above, as the warm steam of a kettle is by the comparatively cold air of a room. But no fog arises till the cold air has absorbed vapor enough to bring it to the point of saturation. Fogs often hang over rivers. Their cause is the condensation by contact with the cold water, of the vapor in a hot and moist air current passing over the river. The "pea-soup" fogs of London life are produced by the carbon of the smoky atmosphere coloring the fog vesicles; a fog which is brown in London's business district is generally white a few miles off, and wanting altogether at the further extremities of the city. On hills and mountains of any size it is easy to rise above a fog, and see it like an ocean beneath one's feet.

Fog-signals, signals given by means of sound or light to warn vessels of danger during fogs. Various kinds of fog-signals are used, among which may be mentioned bells, drums, gongs, guns, compressed-air whistles, steam-whistles, and fog trumpets or horns, and latterly powerful electric flashlights. Gongs are not very powerful as signals, often failing to be heard at more than the distance of a quarter of a mile. Bells may be heard during fogs at a distance of from 1 to 3 miles. Guns have been heard as far as 10 miles, with a light breeze blowing across the sound. One of the most powerful signals is the siren fog-horn, the sound of which is produced by means of a disk perforated by radial slits made to rotate in front of a fixed disk exactly similar, while a long iron trumpet forms part of the apparatus. The disk is made to revolve rapidly, and when the slits are opposite each other openings are formed through which electricity, steam, or compressed air is forced. This causes a sound of very great power, which the trumpet collects and compresses, and which under favorable circumstances is heard from 20 to 30 miles out at sea. Fog-signals are also used on railways during foggy weather. They consist of cases filled with detonating powder, which are laid on the rails and exploded by the engine when it comes up to them. Bell-buoys, common to the coasts of the United States, are operated by the current, by the ebbing and flowing tide, by the swaying of the waves, by the wind, and by clockwork impelled by weight or spring. As to construction, they are adapted for anchorage on spits, sand-bars, or shoals. The use of electricity in fog-signals is well illustrated at Sandy Hook, N. J., where a powerful searchlight flashes every few moments in varying directions. In clear weather this flashlight can be observed a distance of 50 miles at sea. There are in the United States under government control nearly 10,000 fog-signals of all kinds, 3,000 of which are lighted. Eleven buoys are operated by electric light. Germany erected in 1903 a fast flashing light on the island of Helgoland in the North Sea. The system or principle employed is said to be entirely new. Not only that, but it was said to present absolutely insurmountable difficulties. The revolving light on Helgoland is not only the largest in the world, it is the most unique, for Germans claim that it never had a model.

They built upon the superiority of the German reflector, with its exactly parabolic ground-glass mirror or speculum, and the marvelous success of the Helgoland fast-flashing light has justified German effort, skill, and courage. In these lines, for a long time, France was in the lead. It looks as if she would have to guard her laurels. The reflector invented by Schuckert, with its parabolic mirror, is easily earning a place by the side of the world's very best work. It took a long time to get a hearing for the glass parabolic mirror in the lighthouse world. The bright fires — *feux éclairs* — of the system, based upon a combination of Fresnel lenses and totally reflecting ring prisms, which were built by the French with marvelous skill and accuracy, blocked the way to the new lights. About the middle of the nineties German experts were sent to France by the German imperial government for the express purpose of studying flashlights. The experts stayed long enough to find out all that was best in the French system, aided thereto by the kindness of the scientific men of the republic. Before their return they were convinced that by means of two or more reflectors, erected upon a reflector with Schuckert's glass parabolic mirror, results equal to those of France could be produced.

Experiments were made in Nuremberg. They went far beyond what the most sanguine had believed possible. The revolving reflector of the German apparatus was fully equal to the Frenchman's revolving light. As soon as the experts had demonstrated their point, work was begun on a light reflector or projector equal to the largest ever used. It was to represent 30,000,000 candlepower and to last no longer than one tenth of a second. The flashes must follow each other every five seconds. When the weather is favorable the beams go far beyond the central fires of light rays. On the first night that the new light was used, its peculiar, flashing beams were seen by people standing on the mole at Busum, a distance of 65 kilometres, or a trifle over 40 miles. The watchers in the lighthouse at Amrum, about the same distance, were able in unfavorable weather to see the same beams as they rapidly appeared and disappeared. It was noted that the otherwise bluish-white light of the electric arc appeared red. See BUOY; ELECTRIC LIGHTING; FOG; LIGHTHOUSE; MEGAPHONE; SIREN; TOPOPHONE.

Fogarassy, János, yän'ŏsh fŏ'-gä-rŏsh-ĭ, Hungarian lawyer and philologist: b. Käsmark, in Austria-Hungary, 1801; d. 11 June 1878. He studied at Sáros-Pátak, and was graduated in law, became an advocate, and was appointed to an office in the government bureau of finance. His principal claims upon the memory of posterity are his legal works written in the Hungarian tongue. He also published a 'Hungarian Dictionary' (1836), and began, at the suggestion of the Hungarian Academy, a complete dictionary of the language in collaboration with G. Ezuczor, after whose death he finished the work single-handed. It was published in 1861, and for this achievement he was awarded a gold medal by the Academy.

Fogazzaro, Antonio, ăn-tŏ'nē-ō fō-gā-tsä'-rō, Italian poet: b. Vicenza, Italy, 1842. He first came into notice with 'Miranda,' a story in verse (1874), and added greatly to his reputation as a poet with 'Valsonda,' a volume of lyrics (1876). He was author of several novels which were received with marked favor, among them: 'Master Chicco's Fiasco' (1885); 'Daniel Cortis' (1887); 'The Poet's Mystery' (1888).

Fogelberg, Bengt Erland, bengt ĕr'länt fö'-gĕl-bĕrg, Swedish sculptor: b. Grotenburg 8 Aug. 1786; d. Trieste 22 Dec. 1854. He began his art studies in the Academy at Stockholm and in 1820 went to Rome, where he soon made a name. He was among the first to invest the mythologic figures of the North with the graces of the Grecian antique, and the influence of Thorwaldsen is plainly seen in his 'Odin and Thor' in the museum at Stockholm. He also vied with Thorwaldsen in such purely classic subjects as: 'The Dying Argus'; 'Venus'; 'Cupid and Psyche.' He executed two statues of Gustavus Adolphus, and, in collaboration with Byström, the series of colossal statues of the Swedish kings at Stockholm.

Foggia, fōd'jä, or **Capitanata,** căp-ē-tän-ä'tä, Italy, a province on the Adriatic, between the provinces of Campobasso and Bari. It possesses rich pastures. Among its special products are wines, saffron, and fruits. The principal town is Foggia. Area, 2,688 square miles.

Foggia, a city of southern Italy, capital of the province of the same name, in the centre of the great Apulian plain, 46 miles east by south of Campo Basso. It is well built, most of the houses being reconstructed since an earthquake which happened in 1732. It has large storehouses for keeping corn, and is the place where the flocks that feed on the great plain of Apulia are registered.

Foglar, Ludwig, lood'-vĭg fō'glär, Austrian poet; b. Vienna 24 Dec. 1819; d. Kammer 15 Aug. 1889. Among his poems, mostly lyric, are: 'Cypresses' (1842); 'Sunbeams and Shadows' (1846); 'Clara von Vissegrad,' an epic (1847); 'Freedom's Breviary' (1848); 'Joyful and Sorrowful' (1867); 'Saint Velocipede' (1869), a satire (under the pseudonym «LEBRECHT FLOTT»).

Fo'go, Fuego, fwä'go, or St. Philip, (1) One of the Cape Verde islands, in the Atlantic Ocean, and the highest of the group, being 9,760 feet above sea-level, and presenting the appearance of one single mountain, though, on the sides, there are deep valleys; area, 170 square miles. Pop. estimated at 16,000. It has no rivers, and a scarcity of fresh water prevails, yet it is one of the most fertile islands of the archipelago, producing excellent maize and fruits. The chief town is Nossa Senhora da Luz. (2) Fogo, a port of entry and capital of Fogo Island, Newfoundland, at the southwest entrance to Notre Dame Bay, 122 miles northwest of St. John's, N. B.

Fohi, fō'hē, the first Chinese emperor and legislator. He is said to have founded this kingdom 2,207 B.C. Nothing certain is known of his reign; but there are attributed to him the institution of marriage, the invention of fishing, hunting, music, and writing. He acknowledged and worshipped a supreme deity. He is supposed to be the Noah of the Bible.

Föhr, fėr, Germany, an island of Schleswig, in the North Sea; area 31 square miles. The town of Wyk is a fishing centre. The population numbers 4,200, mostly Frisians.

Foil. (1) A leaf or thin sheet of metal placed beneath transparent jewels to heighten their color and improve their brilliancy; also applied to those sheets of tin amalgam placed behind mirrors to make them reflect perfect images. They are made of copper, tin, and silvered copper, and are much used in imitations of precious stones. Colored foils are made by coating the white with any varnish of the required tint. The sheet lead which is used for the lining of tea-chests is a species of foil, and the Chinese purchase about 4,000 tons of lead annually from England for this purpose. (2) In architecture a small arc in the tracery of a window or panel. (3) In fencing. See FENCING.

Foix, Gaston, gas-täṅ fwä, COUNT DE, and VISCOUNT DE BÉARN, French military officer: b. 1331; d. 1391. Acquired the surname of Phœbus. He spent his life in war and the chase. His first service in arms was against the English in 1345. During the revolt known as la Jacquerie he contributed to the rescue of the Dauphin at Meaux. He wrote a book on the pleasures of the chase, of which several editions were published.

Foix, Gaston de, French soldier: b. 1489; d. Ravenna, Italy, 11 April 1512. He had the command of the army of Italy, and on account of the daring exploits was denominated the «Thunderbolt of Italy.» After performing prodigies of valor he was killed at the battle of Ravenna.

Fokien. See FU-KIEN.

Fokshani, fŏk-shä'nē, town in Rumania, population 23,800. Extensive vineyards are in the neighborhood and much wine is produced here. The town is well-known historically. It was destroyed by the Russians in 1789 and by the Turks in 1822.

Fold, in geology, a term used to denote an inclined position into which various disturbances may have moved rocks previously horizontal. Even very brittle rock may be thus folded, rather than broken, under a severe, steady pressure. Three kinds of fold are generally distinguished: (1) monocline, in which the rocks are inclined in one direction only; (2) anticline, in which they are bent up in the manner of an arch; and (3) syncline, in which the arch is bent downward instead of up. Folds are rarely symmetrical. See DIP; FAULT.

Folding Machines. The folding of printed sheets for books or newspapers was performed by hand up to 1856, when Cyrus Chambers, Jr., of Philadelphia, invented a practical folding machine, which was manufactured by him and his brother Edwin, who within a few years produced a considerable line of folders of various sizes and capacities. The folding machine of C. S. Forsaith, of Manchester, N. H., designed for folding newspapers only, came out some years later. A good many Stonemetz folders were sold between 1880 and 1890. The leading folders on the American market to-day are the Dexter, the Chambers, and the Brown. The vital principle on which nearly all paper folders are based is the descent of a dull blade on the paper sheet at the point where the fold is to be made, the blade thrusting the paper between rotating rollers, which draw it in folded. The making of a second fold is accomplished in the same way, the paper being passed along by traveling tapes from one stage to another, up to three or four folds. The earlier machines were not positive in their register, that is, the fold was apt to vary slightly in position, but the modern machines are very accurate, and large 64-page sheets are commonly folded on the machines with entire satisfaction. The heavy coated paper introduced about 1890 to 1895 developed a tendency to buckle or crease slightly on the last fold of a large sheet, and the most recent folding machines have introduced devices to overcome this difficulty. The most conspicuous improvement of recent years has been the drop roll, which has added materially to the speed of the machines. This was introduced by Dexter, and enabled the sheet to be fed sideways — that is, the shortest way. Registering by means of points, that slip into holes or slits in the sheet, is another feature of modern machines. The equipping of machines with pasters was accomplished early in the history of the folding machine, and this feature has been brought to a high degree of perfection. The paste is held in fountains and laid on the paper in strips as it passes by.

Folders are now made in so many styles that the mere enumeration of them requires considerable space. They may be either drop-roll or point-feed; there are quadruple 16s and double 32 folders, some of which insert one sheet within another; there are marginal folders for books and pamphlets and for jobbing work; also large single and combination periodical folders, rapid circular folders, plain circular folders, jobbing circular folders, and various so-called newspaper folders. Then there are special newspaper and periodical folders, combinded folding and wire-stitching machines, combined folding and feeding machines, and combined feeding, folding and wire-stitching machines.

The Dexter combined folding and wire-stitching machine was introduced in 1897, and it is continuous and strictly automatic. It takes the sheets from the platforms of the feeders, and folds, gathers, collates, covers, and wire-stitches, delivering completed copies without intermediate handling.

There are various other combinations and arrangements for special work, which, together with those above named, have greatly reduced the cost of binding books, pamphlets, and periodicals.

On fast web newspaper printing presses there is used a rotary type of folder, that was brought out by the Hoes, and controlled by them for many years, being probably their most valuable patent in connection with these presses. Three folding blades were mounted on a single cylinder, catching the paper three times in a single revolution, thus securing immense speed. The device is not accurate enough for book folders, but it made possible the enormous speeds obtained by the so-called lightning newspaper presses.

The job folding machines for doing odd work of varying sizes, have come into extensive use within a few years. They are small and comparatively simple machines capable of operating at high speed. See AMERICAN NEWSPAPERS.

Földvar, fĕld'vär (ancient SUSSUINUM), a walled town of Hungary, on the slope and summit of a hill, on the right bank of the Danube, 49 miles south of Budapest. Pop. (1900) 12,364.

Folengo, Teofilo, tā-ō'fē-lō fō-len'gō (pseudonym «MERLINO COCCAJO»), Italian poet: b. near Mantua, Italy, 8 Nov. 1491; d. near Bassano, Italy, 9 Dec. 1554. He was the first to win fame as a writer of macaronic verses. His 'Macaronic Work of Merlino Coccajo, Mantuan Poet' (1517–25) comprises the comico-heroic poems, 'Baldus' and 'Moscæa' (War of the Midges). His satire is mostly against monachism. He writes in cynic humor, but under his burlesque lies a vein of serious purpose. Under the pseudonym «LIMERNO PITOCCO» he wrote in Italian the epic satire 'Orlandino' (1526), in ridicule of the story of 'Roland'; then, partly in macaronic, partly in pure Italian, partly in pure Latin, 'The Chaos of Three by One' (1527), in which he darkly recounts the events of his own life.

Foley, John Henry, Irish sculptor: b. Dublin 24 May 1818; d. Hampstead, England, 27 Aug. 1874. His 'Ino and Bacchus' (1840) attracted much notice, and was followed by a succession of admirable classical and ideal works, including: 'A Youth at a Stream'; 'Caractacus'; and several excellent subjects from Shakespeare. The most noteworthy feature of his work, however, was his careful and artistic execution of his statues and busts, which incuded the Hampden and Selden figures in St. Stephen's Hall, Westminster; Goldsmith, Burke, and O'Connell, in Dublin; and the equestrian statues of Lord Hardinge and Sir James Outram, for India, which rank among the finest equestrian sculptures of modern times. The statue of the Prince Consort for the Albert Memorial is also Foley's work, and one of his latest works was a bronze statue of Stonewall Jackson for the State of South Carolina.

Folger, fōl'jĕr, **Charles James**, American jurist: b. Nantucket, Mass., 16 April 1818; d. Geneva, N. Y., 4 Sept. 1884. He was graduated at Hobart College in 1836; and admitted to the bar in Albany, N. Y., in 1839. He became judge of the court of common pleas of Ontario County in 1843; was a member of the State senate in 1861–9; elected associate judge of the State court of appeals in 1871; succeeded to the chief justiceship of that court in 1880; and was secretary of the United States treasury in 1881–4. In November 1882 he was the Republican candidate for governor of New York, but was defeated.

Folger, Peter, American colonist and author: b. England 1617; d. Nantucket 1690. He emigrated from Norwich, Norfolk, to America and settled at Martha's Vineyard in 1635. He was grandfather of Benjamin Franklin, his daughter Abia having married Josiah Franklin and borne the illustrious statesman and philosopher among her 17 children. He was clerk of the courts in 1673 and possessed a literary sprightliness which descended to his grandson, as may be seen from a perusal of his 'A Looking-glass of the Times, or the Former Spirit of New England Revived in this Generation' (1875).

Folgore, fōl'gō-rā, Italian poet. He flourished at the end of the 13th century, but the dates of his birth and death and the incidents o his life are unknown. He wrote a number o sonnets, all of which have been translated int English by Dante Rossetti and J. A. Symonds Their poetic merit is far from contemptible, and they are particularly interesting from the vivid light which they throw on Italian society. Their prevailing tone is one of refined epicureanism, and their style is mainly remarkable for affluence of imagery. «Every line,» says Mr. Symonds, «presents a picture, and each picture has the charm of a miniature fancifully drawn and brightly colored on a missal marge.' See Rossetti, 'Dante and His Circle' (1874); and Navone, 'Le Rime di Folgore' (1880).

Folia'tion, a term restricted by Darwin, and subsequently by geologists, to the arrangement of the constituent portions of a rock in alternating and more or less parallel layers or folia of different mineralogical nature. It differs from cleavage (q.v.), which is applied to certain superinduced divisional planes that render a rock fissile; and from lamination, in which the planes of separation in a rock are the result of deposition in successive layers. If foliation postdate the formation of the rock, the structure is practically the same as that known as schistose. The folia are conspicuously lenticular, thickening and thinning out, and reappearing after an interval on the same or a different plane. These alternately lenticular folia are usually more or less closely welded or felted into each other, so that they are not readily separable; and they frequently present the appearance of being puckered or crumpled. The crystalline texture and the foliated character of the schists distinguish them at once from any ordinary bedded «fragmental rock.» See SCHIST; SCHISTOSE.

Folio, (1) in printing: *a.* The running number of the pages of a book. The even folios are on the left-hand pages, the odd upon the right. The folios of prefatory matter are frequently in lower-case Roman numerals. *b.* A sheet of paper once folded. *c.* A book of the largest size, whose sheets are folded but once, four pages to the sheet; hence it is used generally for any large volume or work. (2) In bookkeeping, a page or opening in an account book. (3) In law, a certain number of words in legal documents. The number varies in the States; thus in some of them, as in England, in law documents, conveyances, deeds, etc., the folio is 72 words; in chancery and parliamentary proceedings 90 words. In New York and other States 100 words constitute a folio.

Fo'lium of Descartes, dā-kart, in mathematics, a curve such that the simultaneous increments of two lines drawn from the generating point of the curve to two fixed points, have always to each other a constant ratio. If the ratio is equal to — 1, the oval becomes an ellipse; if it is equal to + 1, it is an hyperbole.

Folk, Joseph Wingate, American lawyer and political leader: b. Brownsville, Tenn., 28 Oct. 1869. He was graduated at Vanderbilt University, studied law, and was admitted to the bar in 1890. Later he removed to Missouri, where he became prominent in his profession and in political life. As district attorney at Saint Louis, he was active in exposing political corruption and punishing the offenders. Owing to his efforts nearly 20 officers of corporations and city officials were convicted of bribe giving and taking; and afterwards similar corrupt practices in the State legislature were exposed. His fearlessness in attacking a long established evil and his success in accomplishing results won for him the confidence and admiration of the people of the State, and in 1904 he was nominated for governor by the Democratic Party in spite of the opposition of the party machine. He was elected governor of Missouri by a good majority, though the State went Republican in the national election at the same time.

Folk-lore, the science which embraces all that relates to ancient observances and customs, to the notions, beliefs, traditions, superstitions, and prejudices of the common people. Gomme's divisions are: (1) Traditional narratives: (a) folk-tales, (b) hero tales, (c) ballads and songs, (d) place legends; (2) traditional customs: (a) local customs, (b) festival customs, (c) ceremonial customs, (d) games; (3) superstitions and beliefs: (a) witchcraft, (b) astrology, (c) superstitious practices and fancies; (4) folk-speech: (a) popular sayings, (b) popular nomenclature, (c) proverbs, (d) jingle rhymes, riddles, etc.

Folk-lore had been observed and noted by countless writers of early days, but it was not till after the beginning of the 19th century that its value for the elucidation of the social history of mankind had become apparent to thinkers, and its systematic study been seriously begun. Meantime the reawakening to natural poetry, and to the beauty of free emotional expression in literature, which lay at the foundation of what it is usual to call romanticism, had already commenced even in the 18th century, and the publication of Percy's ‹Reliques of Ancient English Poetry› (1765) had given a powerful impulse to Scott and others in England, to Herder, and to Arnim and Brentano in Germany, who found a rich wealth of traditional poetry, the poetic value of which they fortunately had the eyes to see. But the study of folk-songs really began with Scott's ‹Minstrelsy of the Scottish Border› (1802–3). It was perhaps an advantage rather than a disadvantage that the first worker in this new field was but the folk-lorist unawares and mere great poet and romancer of genius that he was; for our folk-poetry would never have enriched and permanently influenced all later English literature but for its own intrinsic and genuine poetic quality, any more than our detached folk-lore facts would ever have risen above the dignity of the whimsical pastime of an idle hour but for their inherent though unsuspected faculty for throwing light backward on the history of human civilization. All, or nearly all, the facts of comparative mythology are to be found in folk-belief in solution; a great many facts of folk-belief are to be found in comparative mythology crystallized. The facts are essentially the same in both cases, but the one study deals with them at one, the other at another stage.

First in importance of the collections of material is still the earliest, the ‹Children and House Tales› (1812–14) of the brothers Grimm (q.v.). Grimm's ‹German Mythology› (1835) is still unequaled in the range of its erudition and in the systematic thoroughness with which the mythology and superstitions of the ancient Teutons are traced back to the dawn of direct evidence and downward in decay and diminution to the popular tales, traditions, and phrases in which they still unconsciously survive. These two works of Grimm created a school, whose abundant labors later folk-lorists have entered into, while they have enlarged the horizon of the science, because the stamp of soundness and sufficiency so far as it goes is impressed in all the work of Grimm and his successors, of whom, in Germany, the most eminent were Kuhn, Mannhardt, J. W. Wolf, and W. Schwartz. To the English-speaking world Max Müller's essays revealed a new world of undreamt-of affinities, and the combined charm of their literary grace, wide learning, and rare powers of exposition converted every reader to a theory which, as has been seen, is only now being displaced by another with a sounder basis of real philosophy and facts. Since then the study of folk-lore has become fashionable, indeed almost an article of patriotism, and societies have been formed in most countries to further its study. Of these the most important is still the Folk-lore Society of England, established in 1878, with its official organ, the ‹Folk-lore Journal.› The American Folk-lore Society was instituted at Cambridge, Mass., early in 1888: (1) For the collection of the fast-vanishing remains of folk-lore in America, namely: (a) Relics of old English folk-lore (ballads, tales, superstitions, dialect, etc.); (b) lore of negroes in the Southern States of the Union; (c) lore of the Indian tribes of North America (myths, tales, etc.); (d) lore of French Canada, Mexico, etc. (2) For the study of the general subject, and publication of the results of special studies in this department. Already its journal has amply justified its existence by a series of articles of striking originality and value.

Folk-lore, though it takes cognizance of many apparently trivial matters, is of great importance in the science of comparative mythology, and helps to throw much light on the relationships between races, and on the origin and development of religious beliefs and ceremonies. It is, therefore, of great assistance to the ethnologist, the sociologist, and the historian, as well as to the student of comparative mythology and of the science of religion. It has attracted much attention in recent times. See ASTROLOGY; FABLES; FAIRY TALES; LEGENDS; MYTHOLOGY; SUPERSTITION; WITCHCRAFT.

Bibliography. — Aubrey, ‹Miscellanies› (1696); Browne, ‹Pseudodoxia Epidemica› (1646); Brand, ‹Popular Antiquities›; Chambers, ‹Book of Days›; Hone, ‹Everyday Book›; Hone, ‹Year Book›; Lang, ‹Custom and Myth›; ‹English Folk-lore Journal›; ‹American Folk-lore Journal.›

Folk-music. The music of a nation is generally based on folk-music, or the folk-tunes that are handed down from generation to generation along with folk-lore. Hungarian folk-music has provided material not only for native composers but for the Germans. Haydn, Liszt, and Schubert utilized the melodies of the Magyars and the Gypsies. Brahms and others did the same thing in Russia. Beethoven went to Scotland and Ireland for melodies and Puccini traveled as far as Japan for one of his operas. Of all European countries Germany and Ireland have probably the greatest variety of folk-songs. (See FOLK-LORE; MUSIC.) Consult: Engel, ‹Study of National Music› (1886); Tinck, ‹Songs and Song Writers› (1900); Parry, ‹Evolution of the Art of Music› (1896).

Folk-psychology, an ethnological study of the psychology of races and people, differing from folk-lore, which studies survivals. Among modern students of this science are Baldwin, Wundt, Lombroso, Lazarus, Steinthal and Felix Adler. Folk-psychology considers the habitat and food conditions of a people, its somatology, sex, technology, æsthetics, jurisprudence and pathology. Nearly all the books written upon this subject have been published only in German. See ETHNOLOGY.

Folk-right, the native laws and customs in Early English history as distinguished from the rules and observances introduced by William the Conquerer and his followers. See ENGLAND.

Folkestone, or **Folkstone,** fōk'stōn, a fortified seaport town of England, in Kent County, 62 miles southeast of London, and 7 west of Dover. It possesses a spacious harbor and fine pier whence the tidal steamers sail twice a day to Boulogne on the French coast. It was the birthplace of William Harvey (b. 1578), the discoverer of the circulation of the blood. Pop. about 32,000.

Folk'land, or **Folcland,** fok'land, the land of the people, that portion of Anglo-Saxon England which was retained on behalf of the community. It might be occupied in common or possessed in severalty, but could not become allodial estate or absolute private property except with the consent of the Witan or highest council in the land. From time to time large grants were made both to individuals and to communities; and land thus cut off from folcland was called bocland or «book-land.» Ultimately the king practically acquired the disposal of it, and the remnant of folkland became crown lands.

Folkmar, Daniel, American anthropologist: b. Roxbury, Wis., 28 Oct. 1861. He was graduated at the Western College of Iowa in 1884 and continued his studies at Paris and Berlin. He subsequently taught in several western institutions of learning (1895–1900) and was professor of anthropology in the Université Nouvelle of Brussels 1898–1901. Among his many writings are: ‹L'Anthropologie Scientifique› (1899); and ‹Leçons d'Anthropologie Philosophique› (1900).

Folkmoot, fōk'moot', or **Folcmote,** in Anglo-Saxon England, an assembly of the people to consult respecting public affairs.

Folks, fōks, Homer, American sociologist: b. Hanover, Mich., 18 Feb. 1867. He was graduated from Albion College (Mich.), in 1889, from Harvard in 1890, was superintendent of the Pennsylvania Children's Aid Society 1890–3, and in 1893 became secretary of the New York State Charities Aid Association. In 1900 he assisted the United States military government of Cuba in reorganizing the public charities of the island. He has written a ‹History of the Care of Destitute, Neglected and Delinquent Children in the United States during the 19th Century.›

Fol'len, August, ow'goost, later **Adolf Ludwig,** German poet: b. Giessen, Germany, 21 Jan. 1794; d. Bern, Switzerland, 26 Dec. 1855. He became extremely popular as the author of ‹Sons of Fatherland,› a patriotic hymn; ‹Malegys and Vivian› (1829), a romance of chivalry; and numerous translations and poetic appeals to the instinct for liberty. He was a brother of Charles T. C. Follen (q.v.).

Follen, Charles Theodore Christian, American professor and Unitarian clergyman: b. Romrod, Hesse-Darmstadt, 4 Sept. 1786; d. 13 Jan. 1840, in the burning of the steamer Lexington, on Long Island Sound. He was educated at

Giessen, and became professor of Latin and history at Coire, Switzerland. His liberalism in politics and theology caused him to be driven from that town, and he was afterward forced to leave Basel, where he lectured on law and metaphysics, for the same reason. He finally took refuge in the United States and for five years (1830–5) was successful as professor of German at Harvard. He then took charge of the First Unitarian Church of New York, a position which he retained for a year (1836–7). He removed to East Lexington, Mass., in 1839.

Follen, Eliza Lee Cabot, American author: b. Boston, Mass., 15 Aug. 1787; d. Brookline, Mass., 26 Jan. 1860. She was married to Charles T. C. Follen (q.v.) in 1828. She published: ‘Poems’ (1839); ‘Twilight Stories’ (1858); ‘Home Dramas’ (1859), etc.

Folly Island, a small island off the coast of South Carolina, in Charleston harbor. It is separated from the mainland by Folly Island channel. It was the scene of several engagements during the Civil War.

Folsom, Charles, American scholar: b. Exeter, N. H., 1794; d. 1872. He was graduated from Harvard in 1813, was in the navy as chaplain and midshipmen's instructor in mathematics, was tutor at Harvard in 1821–3, and librarian in 1823–6. In 1824 he was associated with William Cullen Bryant in the editorship of the ‘United States Literary Gazette.’ As a member of the printing firm of Folsom, Wells & Thurston he long prepared for the press the classical works used at Harvard. Publications: An edition of Cicero's selected orations (1811), and an edition of selections from Livy (1829)

Folsom, Charles Follen, American physician: b. Haverhill, Mass., 3 April 1842. He was graduated from Harvard in 1862, was in the Southern States in connection with the Freedmen's Bureau from 1862 to 1865, and after study in the Harvard Medical School practised medicine in Boston from 1870. In 1877–82 he was lecturer in hygiene at Harvard, and in 1879–88 lecturer in and assistant professor of mental diseases. Among his writings is a volume on ‘Mental Diseases.’

Folsom, George, American antiquary: b. Kennebunk, Maine, 23 May 1802; d. Rome, Italy, 27 March 1869. He was graduated 1822, studied law, and removing to New York in 1837 became librarian of the New York Historical Society. He was a member of the New York State senate 1844–8, and was appointed *charge d'affaires* at the court of the Netherlands 1850–4, and was for some years president of the American Ethnological Society. Among his publications are: ‘History of Saco and Biddeford, Maine’ (1830); edition of the ‘Collections of the New York Historical Society’ (1841), translation of ‘Despatches of Hernando Cortes’; ‘Political Condition of Mexico’ (1843); ‘Documents Relating to the Early History of Maine’ (1858).

Folsom, Joseph L., American soldier: b. Meredith, N. H., 19 May 1817; d. San José, Cal., 19 July 1855. He was educated at West Point, and served four years in Florida against the Indians (1840–4), and in California in the Mexican war. He communicated officially to the government the discovery of gold in that State; and Folsom City on the American River, near the earliest found gold deposits, is named after him, as one who became identified with the development of the State and especially of San Francisco, where he was a large property owner.

Folsom, Nathaniel, American soldier and statesman: b. Exeter, N. H., 1726; d. there 26 May 1790. He was in command of a company at Fort Edward 1755, and of a regiment later, being brigadier-general of the New Hampshire Contingent in the siege of Boston, and was elected to the Continental Congress 1774–5 and 1777–80.

Foltz, Philipp von, fē'lēp fōn fōlts, German painter: b. Bingen 11 May 1805; d. Munich 5 Aug. 1877. At Munich he was a pupil of Cornelius, whom he assisted in the decoration of the Glyptothek and the arcades in the Hofgarten. He was later a professor in the Academy, and in 1865–70 director of the Central Gallery. His historical paintings are minute and faithful in detail and skilfully designed in their pictorial arrangement, but they fail of proper effect from stilted drawing and dryness of color. The Cologne Museum possesses his ‘Minstrel's Curse’ (after Uhland's ballad); the Maximilianeum, Munich, his ‘Humiliation of the Emperor Frederick I. before Duke Henry the Lion,’ and ‘Pericles attacked by Cleon and his Followers.’

Fol'well, William Watts, American educator: b. Romulus, Seneca County, N. Y., 14 Feb. 1833. He was graduated at Hobart College, later becoming assistant professor of mathematics there; was appointed professor of mathematics at Kenyon College, Ohio, 1869, becoming president of the University of Minnesota the same year, later, professor of political economy there. Author of ‘Public Instruction in Minnesota’ (1875); ‘Lectures on Political Economy.’

Fond du Lac, fŏn'do-lăk, a city and county-seat of Fond du Lac County, Wis., on Winnebago Lake, at the mouth of Fond du Lac River, and on the Chicago, M. & St. P., the Chicago & N. W., and the Wisconsin C. R.R.'s; about 60 miles northwest of Milwaukee. Fond du Lac was first settled in 1836 by Germans; became a village 1 March 1847, and a city in April 1852.

Industries, etc.— Fond du Lac has important manufactures and is noted for its dairy and agricultural products. The chief industries, besides agriculture, are lumber, grain, flour, leather, paper, machinery, refrigerators, sash and doors, shoes, wagons, furniture, shirts, etc. The city has four banks, with a combined capital of $500,000, and an annual business of $15,000,000.

Buildings, Churches, etc.— The principal buildings are the Carnegie Public Library, Elks' Club House, Saint Mary's Springs Sanitarium, Saint Agnes' Hospital, and Henry Boyle Roman Catholic Home for the Aged. The city has also an excellent public school system (10 buildings), a parochial school and a cathedral school.

Government.— The city is governed by a mayor, elected annually, and a council of 32 members elected biennially, half each year. Pop. (1900) 15,110; (1910) 18,797.

E. M. Jenison,
Editor ‘Daily Commonwealth.’

Fon'da, N. Y., a town and county-seat in Montgomery County, on the New York C. & H. R. R.R. It is a thriving centre of a large agricultural district, has one bank and several newspapers. Pop. (1910) 1,100.

Fondi, fŏn'dē, the ancient FUNDI, a town of Italy, Naples, in the province Terra di Lavoro, near a lake to which it gives name. It is a bishop's see, and contains a cathedral. The Lake of Fondi (ancient *Lacus Fundanus* or *Amyclanus*) lies between the road and the sea; it sends forth noxious exhalations.

Fonseca, Antonio Manuel da, ăn-tō'nē-o mä-noo-äl' dä fōn-sä'kä, Portuguese artist: b. Lisbon 1796; d. 1893. He studied in the Academy at Lisbon, became a professor there, was in 1839 appointed court-painter and in 1862 was elected corresponding member of the Academy of Fine Arts at Paris. Several of his pictures, which are chiefly of a historical character, were exhibited in the Paris Exposition of 1855.

Fonseca, Juan Rodriguez, hoo-än' rō-drē'-gĕth fōn-sä'kä, Spanish ecclesiastic and statesman: b. Toro, near Seville, 1451; d. Burgos 4 Nov. 1524. He passed through many grades of preferment from the archidiaconate of Seville, to the archbishopric of Burgos, where he became *limosiuero* or private chaplain to the king and queen. In 1493 Ferdinand and Isabella appointed him to superintend the preparations for the second voyage of Columbus and practically to administer the affairs of the New World. He became first president of the Council of the Indies (q.v.), organized in 1511. His conduct in the discharge of this office has been stigmatized by modern historians, and he has been charged with shortsightedness, if not with malignity in his treatment of Columbus, Cortes and Las Casas.

Fonseca, Manuel Deodoro da, mä-noo-äl' dā-ō'dō'-ro dä fōn-sä'kä, Brazilian soldier and politician: b. province of Alagoas 5 Aug. 1827; d. Rio de Janeiro 23 Aug. 1892. He was educated as a soldier and graduated with the rank of sub-lieutenant of artillery in 1849. He saw active service in the Paraguayan war (1868–70), and attained the rank of major-general. In 1887, although a conservative and personally attached to the Emperor Dom Pedro II., he and others felt bound to protest against the acts of the government. They were punished for insubordination, revolted, and proclaimed a republic, which was recognized by the United States and later by the powers of Europe. Dom Pedro was banished and Fonseca was elected president of the government 24 Feb. 1891. In November of the same year he was accused of arbitrary acts and compelled to resign. He was succeeded by the vice-president, Peisoto.

Fonseca Lima e Silva, Manuel da, mä-noo-äl' dä fōn-sä'kä lē'mä ä sēl'vä, Brazilian soldier: b. Rio Janeiro 1793; d. 1862. He entered the Portuguese army in Brazil, and was apointed lieutenant-colonel in the struggle which subsequently took place for the independence of the country. Under the new régime the Emperor Pedro I. chose him as lord chamberlain. When Pedro abdicated (1831) Fonseca sided with the Liberals and rose to high rank in the government, being minister of war (1831), minister of the interior (1836), and in 1851 he was apointed general and commander-in-chief of the army.

Fonse'ca, fōn-sä'kä, or **Conchagüa,** cōn-chä'gwa, a bay on the Pacific coast of Central America, the proposed terminus of a projected interoceanic railway through Honduras. It is one of the largest bays in the South Pacific and affords one of the finest harbors in the world.

Font. (1) In church architecture, the vessel which contains the water for baptism. It is frequently sculptured in stone or marble, with richly decorative designs. The form of font with which we are now familiar seems to have been introduced in mediæval churches. In the early Latin Church, from the time of Constantine, baptism was administered in baptisteries, which were buildings separate from but adjoining the church. (See BAPTISTERY.) (2) An assortment of any particular kind or size of type used in printing, each font containing a proportionate number of letters, figures, spaces and punctuation marks. See TYPE.

Fontaine, Pierre François Léonard, pēār frän-swä lā-o-nar fōn-tän, French architect and author: b. Pontoise, France, 20 Sept. 1762; d. Paris 10 Oct. 1853. He took the second grand prize of Rome 1785, going to Italy in 1786, and there connecting himself with Percier (q.v.), who, as director of the decorations of the Opera, Paris, called him to his aid, a partnership then being formed which lasted till 1814, when Percier retired. They constructed a beautiful stairway in the Louvre; the Arc du Triomph du Carrousel; the arcades of the Rue de Rivoli as far as the Rue de l'Echelle. He retained the favor of Louis XVIII. and Louis Philippe, constructing the Galerie d'Orleans at the Palais-Royal, the Chapelle Expiatoire, the Chapelle Ferdinand, repairs of the Louvre and the Tuileries, and the hospital at Pontoise. He wrote: ‹L'Histoire du Palais-Royal›; and, in collaboration with Percier, ‹Palais, maisons et autres edifices de Rome moderne› (1802); ‹Choix des plus celebres maisons de plaisance de Rome et ses environs› (1809–13); ‹Descriptions de cerémonies et de fêtes› (1807–10); ‹Recueil des decorations intérieures› (1812–17); ‹Residences des souverains› (1833).

Fontainebleau, fōn-tän-blō, a town of France, in the department of Seine-et-Marne, and in the midst of the forest of same name, about 2 miles from the left bank of the Seine, and 37 miles east of Paris. It is well built, partly of stone and partly of brick, with spacious and regular streets; is the seat of a court of first resort, and several public offices; contains fine barracks, a communal college, school of design, public library of 28,000 volumes, public baths, and several hospitals; and has manufactures of calico, porcelain, and stoneware; quarries of sandstone, extensively used in paving the streets of Paris and the roads of the surrounding districts; and a trade in wine, fruit, preserves, cattle, etc. Pop. about 14,300. The castle or palace of Fontainebleau, from which the town derives its chief importance, is one of the most magnificent in France. Many of its sovereigns have made it their favorite residence, and vied with each other in lavishing upon it all the embellishments that art could furnish, without any limitation as to expense. Henri IV., Louis XIV., Napoleon I., Louis Philippe, and Napoleon III. all expended large sums upon it. It is now a summer residence of the president of the republic.

Fontainebleau, School of, a group of artists assembled at Fontainebleau in France by Francis I., where they were employed in decorating the palace. There were two branches, Flemish and Italian; the influence of the latter, led by Rosso dei Rossi (1495–1541), eventually dominated French art (q.v.). See FRANCE: *Painting and Sculpture.*

Fontana, Carlo, kar'lō fōn-tä'nä, Italian architect: b. Brusciato, Italy, 1634; d. Rome 1714. He was a pupil of Bernini. While still very young he executed important commissions, including the Grimazzi and Bolognetti palaces, the monument of Queen Christina of Sweden in St. Peter's, and the fountains of St. Peter, and Santa Maria in Trastavere. He also built the cathedral at Fulda. Among his published works are: 'Il Tempio Vaticano e sua origine, con gli edifici piu cospicui antichi e moderni' (1694); 'Ultissimo Trattato delle acque correnti' (1697); 'L'Anfiteatro Flavio' (1725).

Fontana, Domenico, dō-men-ē'kō, Italian architect: b. Mili, Italy, 1543; d. Naples 1607. Cardinal Montalto (afterward Pope Sixtus V.) engaged him to construct a chapel in the Church of Sta. Maria-Maggiore, and a palace in the garden of the same church. But the pecuniary resources of the cardinal failed and the undertaking would have been interrupted had not Fontana himself supplied the means for continuing the work. Sixtus V. wished to remove the great obelisk now in front of St. Peter's Church, which was then nearly buried under the rubbish, to the middle of the square. Fontana happily executed this gigantic operation in 1586. Among other buildings erected by Fontana by the command of Sixtus V., the library of the Vatican and the aqueduct (*acqua felice*), deserve particular mention. Having been accused of converting to his private use the money received for public purposes, he was deprived of his office by the Pope, but immediately received the offer of the post of architect and chief engineer of the king of the Two Sicilies, and in 1592 went to Naples. He there constructed several canals to prevent inundations, a new road along the bay, and the royal palace in the capital.

Fontana, Felice, fä-lē'chä, Italian physiologist: b. Pomarolo, in the Italian Tyrol, 1730; d. 1805. He was appointed professor of natural philosophy in the University of Pisa, and while retaining this position he formed the museum at Florence which contains an immense number of anatomical preparations in colored wax, which exhibit all parts of the human body in the minutest detail, and in all imaginable positions. They are executed with the greatest skill, and were made by different artists under the direction of Fontana. Fontana wrote several works on scientific subjects, some of which have been translated into German and French. He also made discoveries relative to the application of carbonic acid, and different sorts of gas. He was buried in the Church of Santa Croce by the side of Galileo and Viviani.

Fontane, Marius, mä-rịọs fôṅ-täṅ, French writer and administrator: b. Marseilles 4 Sept. 1838. He met Ferdinand de Lesseps in the Orient and became his secretary, shortly afterward being appointed chief of exploitation and secretary-general of the Suez Canal Company and later administrator and member of the Committee of Direction of the Panama Canal Company. He was implicated with the other officers in the downfall of that company, was condemned in 1893 to two years' imprisonment, but this verdict was set aside on appeal, and after another trial he was acquitted. Among his works are: 'Les Marchands de Femmes' (1863); 'Confidences de la vingtieme annee' (1863); 'Selim l'egorgeure' (1865); 'Zara la rebelle' (1866); 'La Guerre d'Amerique' (1866); 'Le Canal maritime de Suez' (1869); 'Essais de poesie vidique' (1876); 'L'Histoire universelle' (Vol. I. 1881, Vol. X. 1899).

Fontane, Theodor, tā'ō-dōr fōn-tä'nĕ, German author: b. Neuruppin, Prussia, 30 Dec. 1819; d. Berlin 21 Sept. 1898. Among his writings are three volumes on England, one 'A Summer in London' (1854); 'The Sleswick-Holstein War of 1864' (1866); 'The War with France' (1876); and other war histories. His first volume of lyrics, 'Men and Heroes,' was published in 1850; his collected 'Ballads' in 1892. He wrote stories of North German life, as 'Count Petöfy'; 'Under the Pear-Tree' (1885); 'Mrs. Jenny Treibel' (1892).

Fontanes, Louis, loo-ē fôṅ-täṅ, MARQUIS DE, French writer: b. Niort, Poitou, 6 March 1757; d. Paris 17 March 1821. He went in 1777 to Paris, where he acquired a reputation by his poems: 'Le Cri de mon Cœur' (1778); 'Le Verger' (1788); 'L'Essai sur l'Astronomie' (1789); and 'L'Epître sur l'Edit en Faveur des Non-Catholiques' (1789). He also wrote a metrical translation of Pope's 'Essay on Man' (1783). In 1802 he was made a member, and in 1804 president, of the legislative body. His admiration of Napoleon was great; and his oratorical talents were often employed in eulogizing the emperor's acts. In 1810 he entered the senate, and, passing on the fall of Napoleon into the service of the Bourbons, was raised to the peerage by Louis XVIII. His writings, prose and poetic, which are regarded as models of elegance and correctness, were edited by Sainte-Beuve in 2 volumes in 1837, with a critical and biographical memoir.

Fontarabia. See FUENTERRABIA.

Fontenelle, Bernard le Bovier de, bär när lė bō-vyā dė fôṅt-nel, French poet and miscellaneous writer: b. Rouen 11 Feb. 1657; d. Paris 9 Jan. 1757. Although he lived to the age of nearly 100 years, and retained, till his death a remarkable degree of activity, he came into the world so weak that it was not thought possible that he could survive. In 1674 he went to Paris, and soon became known by his poetical effusions and learned works. Before the age of 20 he had assisted in the composition of the operas of 'Psyche' and 'Bellerophon,' which appeared under the name of his uncle, Thomas Corneille (q.v.). In 1683 appeared his 'Dialogues of the Dead,' which were favorably received, although his continual straining after wit and novelty deprives them of the charm of natural ease. His 'Entretiens sur la Pluralité des Mondes' (1686) was the first book in which astronomical subjects were discussed with taste and wit.

Fontenoy, fôṅt-nwä, **Battle of,** one of the most famous battles in the war of the Austrian succession. It was fought at a small village of the same name, in western Belgium. Here 11

May 1745, the French under Marshal Saxe defeated the Allies under the Duke of Cumberland, with very heavy loss on both sides.

Fontevrault, Order of, a branch of the Benedictine order of monks; so named from the place in France where the first monastery of the sect was erected. The order was started in the 12th century by Robert of Abrissel, who brought monks and nuns under one roof, and placed them under the government of a female, because Jesus placed John in subjection to the Virgin Mary, saying: “Woman, behold thy son” (John xix, 26). The founder of the monastery was suspected of immorality, a charge which his followers strenuously denied. In 1106 the order received the sanction of Pope Pascal II.; in 1113 it was exempted from episcopal jurisdiction. In 1177 some monks connected with it came over to England by invitation of Henry II. It was remodeled in 1507 by the Abbess Renée of Bourbon.

Foochow, *foo-chow′*, or **Fu-Chau,** town in China, capital of the province of Fu-Kien, in a plain surrounded by an amphitheatre of hills, on the left bank of the Min, 125 miles northeast of Amoy. It consists of the town proper, surrounded by walls, and of extensive suburbs, which, stretching along both sides of the river, communicate by a stone bridge. The walls, 30 feet high and 12 feet wide at top, are overgrown with grass, and the gates, seven in number, are overlooked by high towers. The streets are extremely dirty, and the lines of shops, crowded with goods or with workmen in the act of making them, make the whole place look like one vast series of market-stalls. The principal edifices are the Ching-hwang Miau, and several other temples. Foochow is one of the five ports thrown open by the Treaty of 1843. The trade is very extensive, but the navigation of the river from the sea to the harbor is difficult. Principal exports — timber, bamboo, fruits, tobacco, potash, paper, and especially for the foreign trade — tea. In 1900 the exports amounted to $3,889,490. The imports in 1900 were of the total value of $4,088,560. Pop. about 650,000.

Food, substances utilized in sustaining or nourishing the body. Of these there are three classes: gaseous, liquid, and solid foods. Gaseous foods consist of the air we breathe; liquid food consists of water, for while other beverages, like milk, tea, coffee, etc., are popularly called “liquid foods,” each is simply water in which solid substances have been dissolved or held in suspension. Solid foods are of three kinds: nitrogenous, non-nitrogenous, and mineral. The nitrogenous compounds build up and repair the nitrogenous tissues of the body and supply a small part of the bodily heat, especially when heat-giving compounds are lacking. Non-nitrogenous compounds are the heat-givers, and not only serve to produce energy and force by maintaining the heat of the body, but also tend to promote the repairs and growth of the body. Common salt is the only mineral substance purposely added to food, the other minerals being contained in the plant and animal compounds eaten by man. For a more extended description of foods see the article NUTRITION.

Food, Adulteration of.— It is practically only within the past decade that the general public has been aroused to the importance of protecting the people against the injurious effects of impure or adulterated foods and drinks. The publicity that has been given to this subject during the past ten years, however — not only in the publications of the U. S. Department of Agriculture but also through the periodical press of the country — has been in the nature of an educational campaign, the results of which are now seen in the efforts of all classes of society to reform the conditions that have made these grievances possible. So far as the American people are concerned, the discovery that much of the customary ill-health, to say nothing of the high death rate, was undoubtedly due to the consumption of adulterated, or impure, food substances, was brought about by the experiments and investigations made by Doctor Wiley, head of the Bureau of Chemistry of the U. S. Department of Agriculture. Largely upon his own initiative he began to study the relative purity of the various food compounds in the market, and these tests showed existing conditions to be so dangerous to health that he continued his work to such an extent that he has carried his research into almost every nook and corner of the food and drug field. Naturally such investigations, and the subsequent publicity that was given to them, aroused much opposition on the part of manufacturers whose products came under the ban of Doctor Wiley's disfavor, and strenuous efforts were made to secure his dismissal from the government service. Public opinion was so strongly in favor of the pure food and drug campaign that the Bureau of Chemistry had inaugurated, however, that Doctor Wiley succeeded in overcoming all adverse factors that had heretofore interfered with his work, and, in 1911, his powers were so increased that he will be able in the future to produce still more effective results.

The most bitter controversy in which the manufacturers and Doctor Wiley have yet participated was upon the subject of the safety in the use of benzoate of soda. Through the experiments made upon the so-called “poison squad,” — a company of students who were permitted to eat the questionable compounds under proper medical supervision — Dr. Wiley came to the conclusion that this was a substance that should never be used as a preservative, and he recommended that it should be eliminated from all foods, or that the compounds containing it should be withdrawn from the market. The correctness of this decision was immediately challenged by the manufacturers whose goods would be affected by the ruling, and the matter was referred to the special board of which Professor Remsen, the eminent chemist, was the head. Here it was decided that benzoate of soda was not injurious, but when Doctor Wiley persisted in upholding his opinion, another investigation was undertaken, with the result that the original finding of the Bureau of Chemistry was upheld in every particular.

Writing upon the subject of preserved meats, Doctor Wiley says: “The use of any kind of a chemical preserving agent on meat is most reprehensible, yet . . . as respects numbers of witnesses, chemical preservatives have an advantage. In a case of this kind, the accused must be considered guilty until proven innocent. . . . No expert would testify that borax has never been injurious — even those who appear in its favor admit that, but plead that it is generally used in small doses and, therefore, cannot be harmful.»

Professor Wiley then goes on to show that, even in small doses, these chemicals must be injurious,— and injurious proportionately to the size of the dose. This applies equally to all chemical preservatives, in other foods.

The principal adulteration to which lard is subjected is admixture with other and cheaper fats. Among the fats which are used for this purpose may be mentioned fat and cottonseed oil. Both constituents are fraudulent, as neither of them can be considered in any sense of the word as lard.

As to meat extracts, salt and glycerol of alcohol are the chief ingredients used as adulterants. Poultry is subject to various minor adulterations, enforced fattening and cold storage. Eggs become stale, and develop poisons and parasites. Fishes are adulterated in various ways. Sardines are packed in oil of a different kind from that indicated on the label; and the fish are misbranded. Oysters are adulterated by means of a complicated process known as «floating;» and by the treatment of shucked oysters with formaldehyde, boron compounds, etc. Needless to say, all such processes are reprehensible.

Butter is colored by means of coal-tar, anilin-dyes, etc. Oleomargarine is itself an impure product, and the coloring of this material is allowed by law, if a tax be paid upon it. In addition to this, oleomargarine is adulterated by means of egg yolks, preservatives, etc. Cheese is colored artificially, misbranded, and subjected to various adulterations in addition.

Nearly all canned foods are adulterated to some extent. Corn, for instance, is adulterated by means of burnt sulphur, or sulphite or bisulphite of soda or potash. Many of the corns and cereals are not adulterated, for the reason that they are so cheap that any adulteration would not pay. Canned corn is adulterated very highly. Starch is added to the water to make it more creamy. Sugar is also employed as an adulterant — strange as it may seem. Saccharin is also used. Sulfate of copper is used for the adulteration of canned peas and beans. Saccharin is also employed, to increase the sweet taste. Sugar and spices are added to canned tomatoes—which are now adulterated heavily. Nearly all canned fruits are also subject to adulteration.

As is well known, olive oil is usually adulterated with cottonseed oil. This is not, however, harmful, and there is not much to be said against it from a dietetic point of view. Cacao butter is adulterated by cheaper fats. The same may be said of other fats and oils and butters upon the market.

Candy is valuable as a food to the extent of the sugar it contains. Poisonous mineral colors are used for coloring matter; also glucose contraining harmful substances, alcohol, etc. Honey is adulterated very extensively. Professor Wiley says that: «Perhaps there is no common food product,— with the possible exception of condimental substances, such as pepper and spices,— that has been subjected to such extensive and general adulterations as honey.» Glucose is employed also «invetted sugar;» cane sugar, etc.

Mince meat is adulterated by means of artificial colors and chemical preservatives. Pie-fillers are adulterated by means of artificial colors. Condiments and spices are, as Professor Wiley points out, adulterated more than anything else on the market.

The question of meat inspection,— the injection of preservatives, etc.,— has been treated in a separate place. See MEAT, INSPECTION OF.

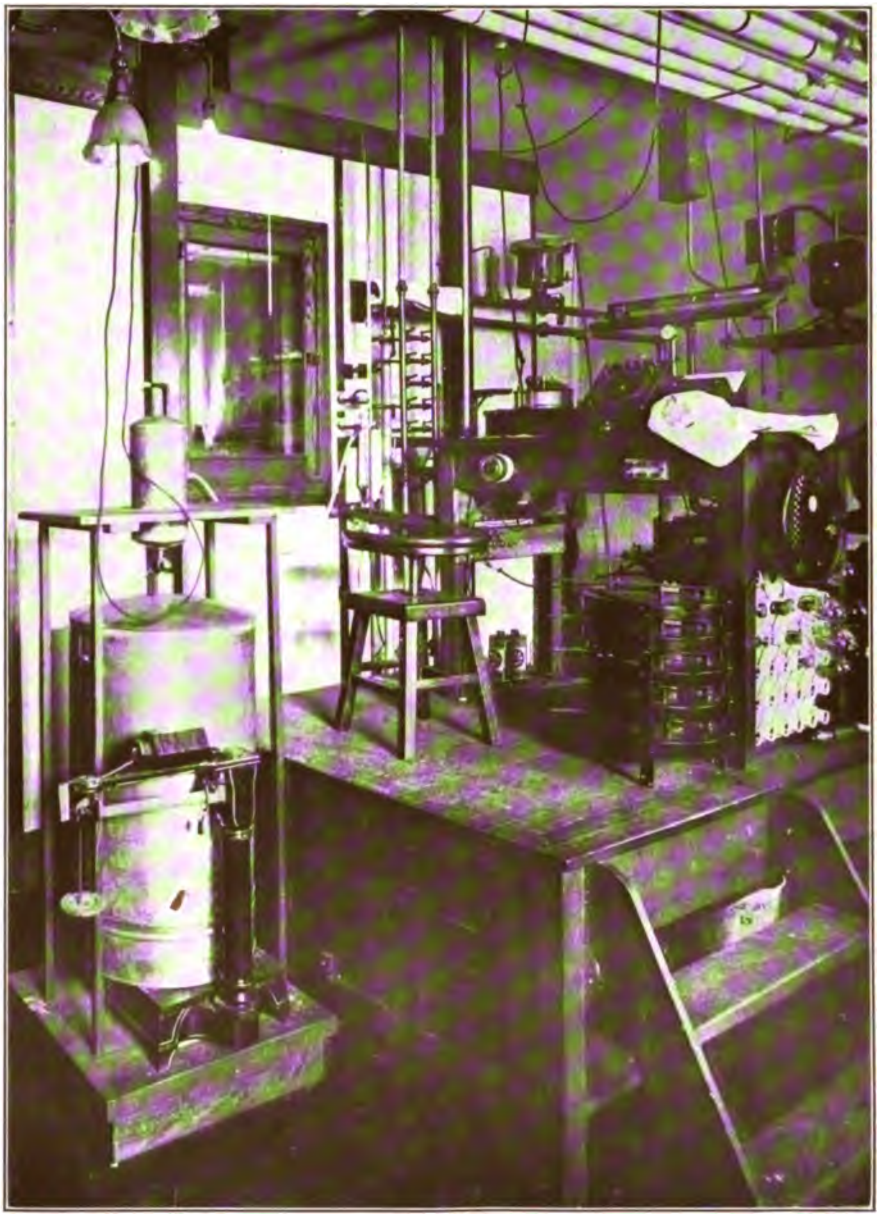
Although, it may be said that while there has been much improvement during the past few years, in the extent of the adulteration permitted, there is still room for great improvement in every direction; and it will probably require the work of several more years to render the food placed upon the American market pure.

When the Pure Food and Drugs Act was passed in June 1906, it was thought that pure food had at length been guaranteed to the people of the United States; but that ideal has now been shattered; and it is known that many of the clauses of that bill are now repealed; so that the label «Guaranteed Under the Pure Food and Drugs Act,» now means so little that it scarcely means anything at all. Since that bill was passed, many of its more important clauses have been repealed; and now coloring matter can be used in ice-cream, cakes, sugar, vegetables, fruits,— anything. Benzoate of soda, salts of copper, sulphites, aluminum salts, are now permitted if declared on the label.

There can be no doubt, too, that many of these laws are abused; and that the amount permitted by law of any adulterant is exceeded. This is one of the chief reasons for prohibiting adulterants altogether; if permitted, an abuse of the law is sure to follow. As Doctor McCann said: «If it is lawful to use 1-10 of 1 per cent of benzoate when the law is looking, how many tenths of 1 per cent will be used when the law is not looking?»

But, in addition to this side of the question, the amount of adulterant which is now allowed by law is doubtless a menace to the public health. At the Pure Food Exhibition, held during the latter part of 1909, in Madison Square Garden, New York, Dr. Lewis B. Allen, chemist of the Massachusetts State Normal School, made a public analysis of some foods, showing what food manipulators dare to do until discovered. Doctor Allen found two samples of baking powder which contained alum and clay. The honesty of the benzoate principles was manifested by three samples of codfish which contained benzoate in excess of the sacred one-tenth of one per cent.

Two samples of cream, one from Yonkers, contained sucrate of calcium,— just slack lime and sugar designed to give body and weight to a cream which had been generously robbed of its butter-fats. Eight samples of flavoring extracts were found to be derived from chemicals derived from others. Twenty articles labeled «vegetable color» were discovered to contain coal-tar dyes and no vegetable dyes at all. Eight articles sold to housewives as preservatives, contained borax, salicylic acid, and benzoate of soda. Whiskey was analyzed which contained no whiskey. It was made of synthetic ether, artificial color, and contained neutral spirits. A piece of baker's cake showed alum, benzoic acid, and coal-tar dye. A num-



A RESPIRATION CALORIMETER.

This delicate machine records to a fraction the amount of energy produced by various foods and expended in different forms of work.

ber of spices were found which looked like spices, and which once were spices. Somebody had abstracted from them the oils to use as flavors in other products, and the residue or waste after the extracting process had been finished, was put on the market. Some ground ginger was partially Fuller's earth. Enough coloring matter was abstracted from some candies to color a number of square strips of cloth with the abstracted dyes.

These are but a few experiments conducted at the Pure Food Show which show us that our foods are still far from perfect; and that «The Pure Food and Drugs Act» fails to protect us completely from all such abuses as these. See FOODS, RECENT LEGISLATION RESPECTING.

The actual adulterants used can sometimes only be detected with considerable difficulty. A large number of these are employed in the case of flour and meal. Mineral matter is added to increase the weight of the flour; alum to improve its appearance; flour or meal from cheaper cereals is added. Flour may also contain seeds of weeds, such as cockle, and purple cow wheat; its water content may be too high; it may be more or less decomposed; or it may be made from a grain infected with fungi. The adulterants used for bread are much the same as those used for flour, save that, in addition to the above list, copper sulphate and zinc sulphate are frequently employed. In all the spices, as before said, much adulteration exists. In ginger, for example, exhausted ginger, clove stems, cayenne, rice, wheat and potato flours, corn meal, tumeric, etc., are employed. Cream of tartar is adulterated with calcium sulphate, calcium carbonate, alum, acid phosphate of calcium, and starch. Baking powders are adulterated by means of bicarbonate of soda, with some acidifying agent, usually bitartrate potassium, acid phosphate of calcium, or alum. Tartaric acid is occasionally used for the purpose. These agents are mixed with some substance called «filling,» which is usually starch, although flour is used sometimes. Ammonium carbonate is also used to increase the strength of the flour.

Vinegar is adulterated by water, pyroligneous acid, mineral acids, usually sulphuric or hydrochloric, caramel, and other coloring matters. Wines are adulterated in various ways — largely by the addition of coloring matters. Volatile acid, in excess of one-fourth of the total acid, is evidence of adulteration. Wines sometimes contain an appreciable amount of copper, lead, and zinc; and occasionally traces of arsenic. This is due to the use of crude glucose and anilin dyes for the purpose of dyeing. Cider is adulterated with water and an alkali to prevent acid fermentation.

Revelations are constantly being made as to the state of the market, and the conditions of so-called pure foods. It is doubtless true that conditions are becoming more and more serious in this direction; and that before long a complete renovation of all such products will be necessary. Only recently, the Government declared a large amount of fish to be «unfit for food.» It was labeled «Italian Cod» — though it had been caught in American waters. Strawberry extract was shown to be a cheap and impure chemical product. Cheese of all kinds was found to be adulterated. Eighty-four bags of coffee was recently seized *en masse*, because it had been found by accident that they were coated with lead chromate,— a poisonous substance,— in order to increase their weight! In all these cases, while the goods were destroyed, the offending parties escaped without punishment, or at most a purely nominal fine.

The extensive shipment and employment of bad or rotten eggs has also aroused the attention of the public. It has been found that a very extensive business has been conducted in these eggs, they being supplied very largely to the bakeries, who use them in the manufacture of pastry of all kinds. It is said that, within two months, no less than 20,000 eggs were supplied by one firm, and disposed of among the trade. The extent of the trade may be judged from this fact. An investigation of the eggs showed that they swarmed with bacteria, and were totally unfit for human food. See also EGGS.

This condition of affairs is not limited to eggs only, but extends more or less to all food-products sold in certain sections of New York City — and doubtless most others. The use of sulphurous acids for the preservation of meats unfit for food has been found to be general among the meat dealers in thickly populated sections. This acid is very largely employed to prevent stickness in cheap adulterated candies, which are sold in large quantities to the children of the poor.

Benzoate of soda, again, may be made the means of covering up a host of filth and imperfections in the foods used. Thus, in one case, the formula for «strawberry jam» is given. It is as follows: «5 per cent strawberries; 10 per cent apple juice (produced by boiling the waste skins and cores); 10 per cent 'apple stock'; 10 per cent sugar; 55 per cent glucose, with sufficient tartaric acid to insure jellying qualities, enough coal-tar to give color, and one-tenth of one per cent benzoate of soda.» This would entitle the producer to label his goods, and state that they were produced under the «Pure Food and Drugs Act,» of 30 June 1906.

Dr. Wiley has no sympathy with any attempt to evade the spirit of the Food and Drug Act, and many of the evasions that were permitted prior to the fall of 1911 were made possible by the fact that the head of the Bureau of Chemistry was restricted as to his power to prosecute offenders. While much has been accomplished in preventing food adulterations, therefore, there is still a great deal to be done in protecting the health of the people.

Food of Plants. See PLANT FOODS.

Food-poisoning, a form of poisoning from food, which in times past was thought to be extremely common, but at the present time is known to occur but rarely. One of the most important features in food-poisoning is individual idiosyncrasy. It is well known that certain foods, such as strawberries and tomatoes, affect susceptible people uncomfortably, but instances of this are rare, and are often of mental origin. Epidemics of food-poisoning have occurred, as when, for instance, a baker has used a yellow coloring matter in his cake to obviate the necessity of using eggs, which coloring matter was largely made up of lead.

Food-poisoning may be classified under three main types: (1) Poisoning by means of metals; (2) poisoning by means of animal parasites; (3) poisoning by means of plant parasites, bacteria and fungi and allied organisms. The metals which have been known to cause poisoning in food are particularly arsenic, lead, copper, antimony, tin, and zinc. During 1900 there was a widespread epidemic from poison by arsenic, in Manchester, England, and neighboring cities, from the drinking of beer. On investigation it was found that the arsenical poisoning, which in some cases proved fatal, was due to the glucose used in the manufacture of the beer. This glucose had been prepared by a sulphuric acid which had in turn been made from iron pyrites containing large amounts of arsenic. It entered into the glucose, and thus became an ingredient of the beer. This epidemic was extremely severe, thousands of cases of arsenical poisoning having been observed. Lead-poisoning very frequently follows the use of water which has been conveyed through new lead pipes. It may also result from the use of leaden coloring matters used in bread, biscuit, cake, etc. Zinc and copper poisoning have resulted from the use of canned vegetables, copper frequently being used to impart a good color to the vegetable.

Food-poisoning resulting from animal parasites or from animal poisons are of extreme interest. Trichinosis from the flesh of hogs, which has been imported in pork and pork sausages, while rare in this country, is common among those people who habitually eat their sausages without thorough cooking. A form of poison results from the eating of mussels which have developed the ptomaine mytilotoxine, and similar forms of poisoning from decomposition products in meat have been observed. A special form of meat-poisoning, botulism (q.v.), is extremely common in certain countries. It seems to be due to the development of the *Bacillus botulinus.* This form of poisoning has been observed in those who have eaten ham. The symptoms are late in onset; from 24 to 36 hours after eating gastric pains with frequent vomiting occur; and constipation is at first obstinate. Practically all the cases of botulism have shown eye-symptoms. There is disturbance of vision, the eyes become fogged, the lids droop, people see double, and there is dilatation of the pupils, while burning thirst and constriction of the throat are frequent signs. Extreme muscular weakness with perhaps loss of ability to speak, or of power to empty the bladder, may develop.

Other forms of food-poisoning have been described resulting from eating sausages and other meats which were diseased at the time of killing, or which have become tainted afterward, and a number of poisonous bacteria have been isolated. *Bacillus enteritidis, Bacillus morbificans, Bacillus breslaviensis, Bacillus Friedebergensis,* have been some of the forms that have been obtained in poisonous meat. Fish-poisons are not unknown, and in Russia and Switzerland and the West Indies a number of cases have been described as resulting from fish-poisoning. A peculiar type of poisoning from milk, ice-cream, cream-puffs, frozen custards, and cheeses is known. This poison seems to be due to the presence of a toxic substance which has been named by Vaughan of Ann Arbor, Mich., as tyrotoxicon.

As to poisoning from vegetable foods, the most important general poisons are those due to eating the poisonous mushrooms, and the grains affected by ergot and allied species. Thus ergotism as found in Russia, Spain, Italy, and its close ally pellagra are types of this form of food-poisoning. A well-known disease in eastern Japan and neighboring parts of Asia, termed beriberi (q.v.), is thought to be due to poisonous rice. See FUNGI; MUSHROOM; PTOMAINES; TOXICOLOGY.

Food Preservation is the method adopted for the preservation of organic substances used as food, either animal or vegetable, and may be considered under the following heads: (1) Preservation by cold; (2) Preservation by drying; (3) Preservation by salting; (4) Preservation by smoking; (5) Preservation by sterilization by heat and the exclusion of air; (6) Preservation by chemical or antiseptic substances.

1. *Cold.*— The application of cold for the preservation of meat and vegetables may now be conducted under modern methods of applying this agent, at temperatures varying from 0° F. (— 18° C.) to 40° F. or more. In the large cold storage plants now established in many cities, in which ammonia is chiefly used for the production of variable degrees of cold, it is customary to provide several large chambers for the preservation of food in which different temperatures are required, fruit being kept at temperatures a little above the freezing point, and meats, fowl and especially fish at considerably lower temperatures.

In densely settled countries like England, where the land is insufficient to produce the necessary amount of meat for the food supply of the people, frozen meat from other countries forms a very large part of the food supply. If the meat is frozen before *rigor mortis* (rigidity following death) supervenes the meat keeps well, but if it is frozen later it rapidly decomposes after thawing. Freezing arrests putrefaction and has a tendency to conceal the odor of decomposition. Hence the bad condition of frozen fish may not be detected until the heat necessary for cooking is applied. Meat which has been frozen, is often unusually tender, on account of the loosening of the intermuscular tissue by freezing; bacteria can more readily penetrate into the interior of the thawed meat, and bring about rapid decomposition. Such meat and fish, especially when thawed too suddenly, lack the flavor of fresh meat. Bacteria in general and especially those which are concerned in the production of putrefaction, seem to be endowed with extraordinary powers of resistance to the action of cold. Colemann and Mickendrick kept flesh six hours in hermetically sealed boxes at temperatures from —6° to —130° C., but in every instance the flesh after being kept at a slightly warm temperature began to decompose in from 10 to 12 hours, though protected from subsequent infection. But cold, though it may not destroy micro-organisms, prevents their development, or at least does so in the case of putrefactive bacteria. There are, however, certain bacteria which are capable of developing in frozen meat, and especially in that which is kept at about 0° C. Lafar attributes to this cause, the unpleasant flavor sometimes acquired by meat which has been kept in a refrigerator for several days. This is confirmed by Popp, who says that the walls of such ice chambers when moist, swarm with bacteria, which in his opinion produce the objectionable flavor often developed in stored meat.

The Detection of Frozen Meat.— Maljean describes a method of detecting frozen meat by microscopic examination of the blood of the meat. A drop of the blood is expressed from the meat upon a glass slide, covered with a thin glass, and examined as soon as possible to avoid solidification. The juice of fresh meat shows numerous red corpuscles of normal color and shape floating in a nearly colorless serum. But the corpuscles of frozen meat are more or less distorted in form and are completely decolorized, while the surrounding fluid is relatively dark in color. On placing a fragment of frozen meat in a test tube, containing some water, the liquid becomes colored more rapidly and intensely than when fresh meat is used.

2. *Drying.*— This is one of the oldest and best known of the various processes of preservation, and applies equally to animal and to vegetable products. By this means, beef and fish of many kinds, grapes, figs, apples, peaches, currants, and many other kinds of fruit are annually preserved by drying, and are thus rendered more suitable for transportation to distant markets, in consequence of great reduction in weight, as well as preservation from decay. The more rapidly the drying process is conducted the better. Drying is conducted in the open air by the aid of the sun's heat, or by artificial means. The curing of fish by drying constitutes an important industry in most northern maritime countries, the principal edible fish employed for this purpose being cod and herring, of which large numbers are dried in the fishing ports of the Atlantic coast north of Cape Cod, and in the British Islands and on the coast of Norway and Sweden. Fish are prepared for drying by the removal of the entrails, slitting them lengthwise, and then drying them in the open air.

3. *Salting.*—Salting is one of the oldest and best-known methods of preserving meat and fish. The most common method of preserving meat, especially pork, is by placing the meat in casks in layers, with salt between each layer. The salt withdraws water from the meat, and the brine thus formed penetrates the fibres of the meat. In Eckart's Munich quick-salting process, the meat is impregnated under pressure with a 25 per cent solution of common salt for 24 hours and then smoked. It is claimed that by this process the loss consists, mainly, of only water and a little phosphoric acid, that the meat has a better flavor, and that trichinæ are completely destroyed. As one of the results of salting meat is the removal of its natural color, it is quite customary to add a small quantity of saltpetre to counteract this effect. According to Lehmann, a small percentage only should be used on account of its harmful effect. Five grams of this salt have caused severe illness and eight grams have been known to cause death. The effect of the continued use of meat containing saltpetre, upon the human system, has not been determined by observation or by experiment.

Influence of Salting Upon Bacteria.— Forster's experiments show that the streptococci of erysipelas and many other well-known bacteria can live for weeks and even months in salted meat. The bacilli of tuberculosis retain their virulence for more than two months, and while the bacteria of anthrax perish in less than a day, their spores retain their vitality for a much longer period.

Effect of Salting Upon Flesh.— Salted meat is harder and more difficult of digestion than fresh meat. Voit shows by analysis that the nutritive value of meat is only slightly diminished after 14 days' salting. He found the percentage loss to be for water 10.4, organic matter 2.1, albumen 1.1, extractives 13.5, phosphoric acid 8.5. The amount of salt taken up by 1,000 grams of fresh meat was 43 grams. Polenske, on the contrary (Jahresbericht Nahr. u. Genussmittel 1891, p. 40), found that the meat, after being salted for three weeks lost 7.7 per cent of its nitrogenous constituents, and 34.7 per cent of its phosphoric acid, and after three months and six months the loss was still greater. He therefore concluded that the meat was greatly altered in its nutritive character, and that it could not be used continuously without injurious effects. Salted pork constituted a very important part of the food ration of the Union army in the Civil War, and when accompanied with an abundant supply of fresh vegetables, it was considered a wholesome article of food. Absence of the latter, however, was often the cause of serious illness. Strohmer gives the following analysis of fresh and salted herring:

	Fresh herring	Salt herring
Water	80.7	46.2
Nitrogenous substances	10.1	18.9
Fat	7.1	16.9
Ash	2.1	16.4
Salt	....	14.0

Caviare.— This is the salted roe of the sturgeon and other fish. It is prepared by washing the roe with salt water, leaving it in the brine for some time, pressing it, again treating it with salt water, passing it through a hair sieve, and finally packing it in salt. The most highly prized is the Astrakhan caviare, which is prepared at the mouth of the Volga. The following analyses of caviare are compiled from the works of Gobley and of König:

		Caviare	Pressed caviare
Water		43.89	30.89
Nitrogenous substances		30.79	40.33
Fat		15.66	18.90
N-free substances		1.67	....
Ash		8.09	9.88
The dry substance	N-substances	54.89	58.36
	Fat	24.02	27.35
	Nitrogen	8.78	9.36

4. *Smoking.*— The preservative qualities imparted to meat or fish by smoking are due partly to the drying action of heat, and partly to the antiseptic action of some of the substances of which smoke is composed, namely, creosote, formaldehyde, and pyroligneous acid. The smoke coagulates the albumen of the meat, and forms a protecting envelope. The best woods for the production of such smoke for preserving are beech, birch, and poplar, the conifers being unsuitable in consequence of the resin which they contain. There is no loss of nutriment, and Strohmer found that smoked meat is as digestible as fresh meat. Smoking may be con-

ducted in two ways: (1) by slowly smoking the meat for 24 hours at 25° C., or in the case of sausages and fish at 70° C., and then for a short time at 100° C.; (2) the meat may be placed directly in the hot smoke. Products prepared by the slow process have been found to contain more micro-organisms than those made more rapidly. The smoking should be continuous and not intermittent.

Action on Bacteria.— Serafini and Ungaro found that smoke acts energetically on pure cultures of bacteria, those of anthrax being killed in 2½ hours, and anthrax spores in 18 hours. Bacilli in the interior of the meat were not killed. Forster found the bacilli of tuberculosis still virulent in the interior of meat after it had been salted and smoked.

The following analyses of smoked and salted meats and fish are from the works of Strohmer and König:

	Water	Nitrogenous substances	Fat	Ash	Common Salt
Ham	59.73	25.08	8.11	7.08	....
Smoked beef...	47.68	27.10	15.35	10.59	....
Smoked herring	64.49	21.12	8.51	1.24	....
American bacon	9.15	9.72	75.75	5.38	....
Mackerel	44.45	19.17	22.43	13.82	11.42
Salmon	51.46	24.19	11.86	12.04	10.87

During the process of salting and smoking the coloring matter of meat is changed, as shown by the spectroscope. Smoked ham and other meats have an alkaline reaction.

5. *Preservation by Exclusion of Air After Sterilization by Heat.*— In early times food was preserved to a limited extent by heating in earthen vessels, and sealing hermetically by such crude processes as were available. At the present day such methods have given place to preservation, either in tin cans or boxes or in glass. In the former instance food may be preserved for long periods, by means of soldering, and in the latter by means of tight-fitting joints and rubber rings. The latter method is not so much used in trade, but is largely employed for domestic purposes. The prudent housewife also makes use of surface layers of paraffine and waxed paper for the temporary exclusion of air. Tin cans are stronger, and more tight, and more economical. Almost every kind of perishable food is now preserved in this manner.

In the United States the preservation of meats, poultry, fish, vegetables, and fruits in this manner has become an important industry and branch of commerce, both domestic and international. The canning of meats is conducted to a great extent in those cities where great slaughtering establishments are located. The canning of vegetables and fruits is carried on at places located among the great fruit-producing regions, while the fish canneries are mostly upon the rivers and in the seacoast towns of the northeast and northwest States and Provinces where the fish are taken from the water. The cans filled with their contents are either heated in steam retorts or immersed in boiling water. A small hole is left in the cover, and while still hot, the hole is closed with a bit of solder. In a few days the cans are tested by tapping them with a wooden mallet or hammer. If the cap sinks slowly, the can has been properly sealed, but if it is elastic, and springs back, it is rejected as a «swell-head.» In the preservation of corned beef, the cans are pierced to allow the water and fat to escape, and are then soldered and placed in boiling water again for several hours.

Canned roast beef is largely used as a part of the army and navy ration, especially during the time of war, and upon the frontier. The method of preparation is thus described by Munson: «The beef is first placed in water and maintained at a temperature of 95° C. until well cooked. It is then removed, trimmed and placed in cans, a little gelatine being added to bind the meat together. The cans are then sealed and either submerged in boiling brine, or placed in superheated steam at 125° C. The steam in the can escapes through a puncture made in the top of the can which is immediately afterward closed with solder. The meat being sealed while hot, any portion of enclosed space is a partial vacuum; consequently a good can of meat will usually present a concave appearance on the outside, from atmospheric pressure.

When a can is bulged it is bad — unless frozen — and should be rejected. Freezing causes a bulging of the ends of the cans without injury to their contents. The ends, after the contents are thawed, return to their former shape, unless this process has been several times repeated.

The process of canning involves the making and soldering of two punctured holes in the top of each can. The presence of three such holes is evidence that the can had been imperfectly treated, and that it was reheated, the gas allowed to escape and the hole punctured for this purpose again sealed. The contents of such reheated cans are more likely to be of inferior quality than those of properly prepared cans. On this account the packers are careful to make the third puncture as inconspicuous as possible, and often to conceal it entirely by making it on the side of the can near the top and pasting the label over it. This may usually be detected by running the finger around the rim of the can.

Sometimes newly packed cans are so much swollen that reheating is not sufficient. In such cases the cans are opened, the contents sorted and the sound parts repacked in cans as before. The quality of such articles can only be determined by opening the cans and examining their contents, which present an overcooked appearance. First-class canned goods have the name of the manufacturer and often that of the wholesale house through which they are sold upon the labels, while doubtful goods have a fictitious factory name and no dealer's name.

Canned peas are subject to great variations in quality. Dried peas are bought in large quantities, soaked, heated and canned. Such articles can usually be recognized by their appearance and taste on opening the cans. To such an extent is this done as to have led to legislation in some States requiring all such cans to be legibly marked «soaked.»

French canned peas and beans are often colored with sulphate of copper, which improves their appearance, but not their taste. The sale of such articles is forbidden in some countries.

The Composition of Canned Meats.— König found the following results in samples of canned meats and salmon. From 48 to 65 per cent of water, from 15 to 33.8 per cent of nitrogenous substances, from 0.2 to 21.6 per cent of fat, and from 2.3 to 21 per cent of ash. Of the water-free substances, there were from 43 to 78 per cent of nitrogenous substances, and from 0.3 to 43 of fat. The albuminous substances were generally less than those of fresh meat, the actual figures varying in different kinds of meat, from 87.06 to 93.94 per cent as much as that of fresh meat. The preservation of food by hermetic sealing in cans has, within the last half century, grown to be an important factor in the commercial and industrial development of the United States. Before 1795 drying and the use of salt and sugar were the only methods used to any considerable extent in the preservation of food. Nicholas Appert, a Frenchman, stimulated by the offer of a reward for a mode of preserving food for use at sea in the navy, submitted to his government a treatise upon the hermetic sealing of all kinds of food. His principle, as set forth in this work, was practically the same as that which is now in use, the exclusion of air, and the application of heat for the purpose of sterilization. France first purchased his process and the industry soon spread to England and Ireland.

One of the first persons who introduced the industry into the United States was Ezra Daggett, who arrived in New York between 1815 and 1818. In 1819 he was engaged in the manufacture of hermetically sealed goods, chiefly salmon, oysters, and lobsters. William Underwood arrived at New Orleans from London in 1817, having learned the trade of pickling and preserving with the house of Mackey & Company. Not liking the climate of the South he walked from New Orleans to Boston, where he and Charles Mitchell introduced the same industry, applying it to pickles, sauces, jams, and fruit. Glass jars were at first used, but on account of their expense and fragile nature, they were soon largely supplanted by tin cans, which were introduced in 1825 by Thomas Kensett. The making of tin cans for this purpose became an important industry, various improvements being made from time to time in the processes of manufacture.

During the Civil War large quantities of canned meats, tomatoes and other vegetables and fruits were furnished both to the army and to the navy, and during the Spanish war the use of preserved meats treated with chemical antiseptics at one time threatened to become a lively campaign issue.

According to the census of 1905 there were in that year 2,703 establishments for the canning and preserving of fruits and vegetables, fish and oysters in the United States, having an aggregate capital of $70,082,076. The value of their products was $108,505,471. The number of wage-earners averaged 50,238, and $14,218,170 were paid for wages. Of the total capital, $47,629,497 was devoted to the canning of fruits and vegetables, $19,853,016 to fish, and $2,599,563 to oysters. The imports of canned or preserved fish, fruits, and vegetables in 1910 exceeded the exports by fully $12,000,000.

The capital devoted to the canning of fruits and vegetables had increased from $2,335,925, in 1870, to $27,743,067 in 1900, and the number of establishments from 97 to 1,808.

The number of establishments in the New England States in 1905 was 95, in the Middle States 1,105, in the Southern States 296, Central 464, Western 19, Pacific 219. The largest numbers in single States were in New York 549, Maryland 384, California 167, Michigan 114, Virginia 159, New Jersey 59, Ohio 77, Illinois 62, Indiana 96, Maine 77, and Delaware 59. The value of the products was, in California $23,809,988, in Maryland $12,466,549, in New York $11,589,397 and in Indiana $5,086,896. The principal preserved fruits and vegetables in value were tomatoes $13,926,749 (641,219,993 pounds), corn $8,230,975, peas $4,679,426, beans $2,124,208, peaches $4,414,277, pears $2,233,166, apples $1,160,728, apricots $1,591,567, dried apples $1,913,142, dried prunes $970,927, and raisins $720,268.

The drying of fruit is confined chiefly to California and New York, these States reporting 87.2 per cent of the total number of pounds. Maryland leads in oyster canning and is among the first in the canning of tomatoes, corn, peaches, peas, lima beans, pears and pineapples. Maine is the leading State in sardine canning, and New York leads in canning corn, apples and pears.

Fish Canning and Preserving.— The number of establishments devoted to fish canning and preserving in the United States in 1905 was 373, having increased from 110 in 1899. Of the total number in 1905, 141 were in Maine, 50 in Massachusetts, 63 in Alaska, 36 in Washington, 25 in Oregon, and 13 in California. The value of products in 1905 was $26,377,210, of which Maine produced $5,055,091, Washington $3,187,149, Alaska $7,735,782 (or about the same amount paid Russia for this territory), and Oregon $2,577,746.

By far the greatest capital employed in any single city in fish preservation was in Gloucester ($1,479,647), and secondly in Seattle, Wash., $336,620.

The canning of fish was introduced at Eastport, Maine, in 1843, lobsters and mackerel being preserved in this manner. Establishments for salmon canning were started on the Columbia River in 1866, and at Klawak, Old Sitka and Cook Inlet in Alaska in 1878 and 1882. The labor in these salmon canneries is chiefly performed by Chinese. The sardine canning of Maine is next in importance to the salmon canning of the Pacific coast. Sardine is a general term applied to various small fishes, the best known being the young of the pilchard (French) and the young of the sea-herring (coast of Maine). The fish are first fried in oil, and then placed in a can with oil. Olive oil or peanut oil are chiefly used in France for this purpose, and cotton-seed oil in Maine.

The number of establishments engaged in oyster canning in the United States in 1905 was 69, of which 11 were in Maine, 7 in Florida, and 9 in South Carolina; $2,599,563 in capital was devoted to this industry, and the products were valued at $3,986,239, of which two thirds were produced in Maryland. In canning oysters in large quantities, steam is employed, the oysters being put into a steam-tight box and submitted to the action of steam for 15 minutes, by which process they are more readily opened and made ready for canning.

The extent and importance of the food canning industry of the United States may be estimated by the fact that 400,000 persons are employed in the work of canning, manufacture of cans, packing boxes, etc. It would require 60,000 freight cars to transport a year's product; 750,000,000 cans, 2,000,000 boxes of tin plate for the cans, and 30,000,000 wooden packing boxes.

6. *Preservation by Chemical Substances.*—For many years it has been the custom to employ salt, sugar, alcohol, and saltpetre for the purpose of preserving meat and fish, and some of these substances for the preservation of fruits and vegetables, and no objection has been made to this practice; but in more recent times, and since preserved food has come into more general use, the practice of using other substances has also largely increased. The question whether the use of such articles for this purpose may be injurious to the health of the consumer does not appear to have been yet satisfactorily settled. The experiments of Tunnicliffe and Rosenheim would appear to show that food mixed with boric acid and borax, taken separately and together in such quantities as are ordinarily employed, may be eaten with impunity, but earlier observers have arrived at contrary conclusions. On account, therefore, of the possibility of the use of such chemicals in the preservation of food by persons wholly unacquainted with their physiological properties, legislation appears to be tending in the direction either of prohibition of the use of chemical preservatives or of regulating their use by making their presence known to the consumer. Many substances have been experimented upon with reference to their preservative quality, among which are sulphur dioxide, sulphites and bisulphites, boric acid and its compounds, fluorides, chlorides, alum, lime, sodium carbonate, formaldehyde, benzoic and salicylic acid and their compounds. At the present time boric acid, salicylic acid, and formaldehyde appear to be most frequently used.

Boric acid is most often used for the preservation of meats, certain kinds of fruits and catsup, and upon hams and fish. The latter are found to keep longer if the boric acid is rubbed over the outside. Two grams per kilo is sufficient for fish. According to le Féré boric acid is eliminated slowly from the system, having been detected in the urine 40 to 50 days after it had been taken. It does not appear to interfere seriously with digestion so far as could be concluded from experiments. Cases of flesh poisoning have been reported from Switzerland, where meat had been preserved with borates, which had not acted sufficiently as preservatives, but had only masked incipient putrefaction.

Sulphur and its compounds have been used to some extent for the preservation of food, but not so much at present as formerly. These compounds and especially sulphur dioxide have a powerful germicide action. Authorities differ as to their physiological action. Polli found that 8 to 12 grams of sulphite were not injurious to adults. Ostertag, Bernatzik, and Braun found that one gram of magnesium sulphite caused disorders of the stomach in women. Fischer found that 50 per cent of the preserved meat products sold in Breslau in 1895 contained sulphites, the quantity of sulphur dioxide varying from .34 to .01 per cent. According to Riche, sulphurous acid and its salts, especially calcium bisulphite, have a considerable action on meat, altering its normal condition. This action causes changes in the soluble proteid substances. An addition of 1 per cent of a sulphite to meat is not perceptible to taste or to smell. On cooking the meat the sulphite is only partially decomposed and expelled. Fischer states that meat containing more than 0.1 per cent of sulphur dioxide should be regarded as injurious to health.

Salicylic acid is one of the constituents of many of the modern meat preservatives. Bersch placed a portion of the flesh of a recently slaughtered animal in a concentrated aqueous solution of salicylic acid, and found that after four days the exterior of the meat was perfectly sound, but the interior showed signs of putrefaction, and contained many micro-organisms. He therefore concluded that the preservation of fresh raw meat by salicylic acid was not practicable. In such meat compounds as sausages and potted meat, where the salicylic acid is uniformly distributed through the mass, its germicidal properties would obviously exert a more decided action. On account of its decided taste it cannot be used so freely in meat preparations as in other kinds of food in which the taste of the preservative is concealed. Here again authorities differ as to the action of this preservative on the human economy, when used in connection with food substances. The Paris Academy has forbidden even the least addition of salicylates to food, on account of their liability to injure the kidneys or digestive organs, when any weakness of these organs exists.

Formaldehyde.— In recent years formaldehyde has been introduced as a preservative in consequence of its powerful antiseptic action. A proprietary preservative known as "Carnolin" consists of a 1.5 per cent solution of formaldehyde slightly acidified. It exerts a decided antiseptic action on milk in very small amounts. The effect of salicylic acid upon the system, when employed in the small proportions required for food preservation has not yet been well determined, but its power of forming insoluble compounds with proteid substances, and its hardening power upon animal tissues, would seem to render meat treated with it much less digestible than otherwise. Mahery and Goldsmith found that formaldehyde in the proportion of 0.2 gram limited the artificial peptic digestion of blood fibrin. Ludwig states that formalin is not applicable to the preservation of meat products. Ehrlich tried the effect of an 8 per cent. solution of formaldehyde on various food substances. He found that horseflesh was completely preserved by it, but that the odor developed was such that the meat could not be eaten. Beef thus treated did not develop this odor, but was only fit to be eaten for a short time after addition of the preservative, on account of the chemical changes which it produced. According to Bloxam formaldehyde causes fish to become so hard as to be unsalable even if the solution contains only one part in 5,000.

British Investigation Relative to the Use of Preservatives.— A committee was appointed in 1899 to report to Parliament upon the "Use of preservatives and coloring matters in food," the object of the investigation being to ascertain:

1. Whether the use of such materials, or any of them, for the preservation and coloring of food, in certain quantities, is injurious to health, and if so, in what proportions does their use become injurious?

2. To what extent and in what amounts are they used at the present time?

This committee held many hearings and examined 78 witnesses, among whom were the principal experts in England, physicians, health officers, chemists, grocers, diarymen, and representatives of different food interests.

The committee reported that the preservatives found in use other than alchol, oils, vinegar, salt and sugar, were boric acid and other boron preservatives, sulphurous acid, and sulphites, fluorides, salicylic acid, benzoic acid, and formalin or formaldehyde. A list of 4,251 articles of food examined at the government laboratory for preservatives was presented, of which 1,659, or 39 per cent, were found to contain preservatives. These consisted of 35 different kinds of food and beverages. The articles in which the greatest ratio of preservatives was found were lime and lemon juice, 88.5 per cent, ham 82.7 per cent, cream 77.9 per cent, margarine 77.4, pork-pies 70.8, cordials 70.8, bacon 70.5, sausages 66.4, fruit syrup 65.2, butter 57.1.

Of the 1,659 samples treated with preservatives, 1,249 contained boron compounds, 320 salicylic acid, 20 formalin and 143 sulphites.

The committee were of the opinion that preservatives should not be used in milk, since the milk producer might be liable by such use to protect himself against the immediate results of scrupulous cleanliness. Under the influence of preservatives milk may be exposed without sensible injury to conditions which would otherwise render it unsalable. It may remain sweet to the taste and smell, and yet may contain disease germs of various kinds, whereof the activity may be suspended for a time by the action of the preservative, but may be resumed before the milk is digested.

The following were the general conclusions of the committee, so far as preservatives are concerned:

a. That the use of formaldehyde or formalin or preparations thereof, in food and drink be absolutely prohibited, and that salicylic acid be not used in a greater porportion than one grain per pint of liquid food, and one grain per pound of solid food; its presence in all cases to be declared.

b. That the use of any preservative or coloring matter whatever in milk offered for sale in the United Kingdom be constituted an offense under the food and drug acts.

c. That the only preservative which it shall be lawful to use in cream be boric acid or mixtures of boric acid and borax, and in amount not exceeding 0.25 per cent expressed as boric acid, the amount of such preservative to be notified by a label upon the vessel.

d. That the only preservative permitted to be used in butter and margarine, be boric acid, or mixtures of boric acid and borax, to be used in proportions not exceeding 0.5 per cent expressed as boric acid.

e. That in the case of all dietetic preparations, intended for the use of invalids or infants, chemical preservatives of all kinds be prohibited.

The following statement appears in the 33d annual report of the State Board of Health of Massachusetts (1901). Out of 7,323 samples of milk examined with special reference to the presence of preservatives, 184, or 2.5 per cent, contained formaldehyde; 42, or .6 per cent, contained boric acid, and 7 contained carbonates. These samples were all obtained in the summer months.

Legislation Relative to the Use of Presevatives.— At present Austria has no law upon this subject. In Belgium the use of preservatives in milk is forbidden; in Denmark the use of all preservatives except salt in butter and margarine. In France the sale of food containing either salicylic acid or formalin is prohibited. In Germany, spoiled goods sold in a state concealing their real condition make the vendor liable to a penalty. The addition of alum, boric acid and salicylic acid to wine is also forbidden. The following conclusions have been reached by the Imperial Health Board of Germany regarding the use of sulphurous acid in mince meat:

(1) That mince meat can be made, if kept at a low temperature, to retain its natural color for more than 12 hours; (2) that the addition of preservatives can improve the natural color of meat, but not the meat itself; (3) that the consumption of mince meat treated with acid salts may be injurious, especially to people of delicate health.

The Imperial Health Board has also conducted experiments that have shown danger in the use of boric acid and its compounds.

See ADULTERATION; FISH AS FOOD; FOOD; MEAT; MILK; REFRIGERATION, etc.

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Foods, Recent Legislation Respecting. The Food and Drugs Act of 30 June 1906 commonly called the "pure food law," forbids the importation into the Uniteed States, the exportation from the United States, the introduction into interstate commerce, and the manufacture and sale in the District of Columbia and the Territories, of misbranded and adulterated food and drugs. The law is administered under the direction of the Secretary of Agriculture and provides that the Secretary of the Treasury, the Secretary of Agriculture, and the Secretary of Commerce and Labor shall make uniform rules and regulations for carrying out its provisions. Such regulations have been made and are printed, together with the act, for distribution by the Department of Agriculture. The opinion of this Department regarding various features of the law is expressed in Food Inspection Decisions published from time to time from the office of the Secretary. Under date of 17 Oct. 1906, 40 rules and regulations for the enforcement of the act were adopted. Since then, up to 23 July 1910, seven of these regulations (Nos. 3, 9, 15, 17, 19, 28, and 34) were amended by Food Inspection Decisions. These amendments refer to sections of the law relating to the Collection of Samples, Change in Form of Guaranty Legend, Wholesomeness of Colors and

Preservatives, Benzoate of Soda, Labels, Character of Name, Labeling of Derivatives, Denaturing, and The Use of Copper Salts and Sulphur Dioxide.

The organization which has the enforcement of the Pure Food Law includes: (1) Inspectors who procure samples for analysis and information regarding the manufacture and sale of food and drugs; (2) Chemists and clerks, in the laboratories of the Bureau of Chemistry in Washington and in the branch laboratories in other cities, of which 19 are in operation; (3) Board of Food and Drug Inspection, whose duties are to consider all questions arising in the enforcement of the Food and Drugs Act, upon which the decision of the Secretary of Agriculture is necessary; to consider and supervise all correspondence involving interpretations of the law; and to conduct hearings based upon alleged violations of the Food and Drugs Act. Information secured by the inspectors and laboratories regarding violations of the law is reported by the Chief of the Bureau of Chemistry to the Board of Food and Drug Inspection, which when the charges appear to be sustained, makes recommendations to the Secretary of Agriculture regarding the exclusion of adulterated and misbranded food and drugs offered for importation, and prosecutions for the sale of domestic goods in violation of the law. All persons charged with violations of the law are afforded a hearing at which they may introduce testimony. When requested, the hearing is conducted personally by the Secretary of Agriculture. The act provides that its penalties shall not be visited upon dealers protected by a guaranty, and in enforcing the law the Department attempts to protect the retail dealer who may be acting in good faith, and to place the responsibility upon the shipper or manufacturer who is aware, or should be, of the nature of the product. The enforcement of the law naturally proceeds along two lines: First, products imported into the United States from foreign countries; and second, products manufactured or sold in the District of Columbia or the Territories, introduced into interstate commerce, or exported from the United States. In the case of imported foods and drugs no prosecutions are made. The effort of the Department in enforcing the law is confined to preventing the importation of illegal goods and causing their reshipment beyond the jurisdiction of the United States.

From the nature of the case the method of inspecting domestic foods and drugs is necessarily widely different from that employed with imported goods. For this purpose inspectors visit all sections of the country to secure samples for analysis and such information as may be required by the Department. One inspector is located at each of the branch laboratories and others have their headquarters at Burlington, W. Va., Des Moines, Oklahoma City, Dallas, Tucson, Salt Lake City, Spokane, and Fargo.

The duties of the inspectors are as follows: (1) To investigate the wholesale and retail market and obtain samples of foods and drugs shipped in interstate commerce; (2) To inspect manufacturing establishments and secure information in regard to the nature of the foods shipped in interstate commerce; (3) To investigate the manufacture and use of substances which are or maybe employed for the adulteration of foods and drugs and methods of preparation which may lead to the damage or deterioration of foods and drugs, or to the use of improper materials in their manufacture; (4) To inspect foods and drugs imported at ports where branch laboratories have not been established. Special investigations are frequently made concerning important questions concerning sanitation and processes of manufacture. The efficient and complete enforcement of the law depends to a large degree upon the originality and initative of the inspectors.

The law provides that adulterated or misbranded food or drugs sold or offered for sale in the District of Columbia or the Territories, imported, delivered for export, or introduced into interstate commerce, may be seized and disposed of by destruction or sale as the court may direct. The owner may in the discretion of the court be put in possession of such goods, however, on paying the cost of the proceedings and executing and delivering a bond that the articles shall not be disposed of contrary to the provisions of this act or to the laws of any State, Territory, district, or insular possession.

The act provides that the determinations as to adulteration and misbranding shall be made in the Bureau of Chemistry of the Department of Agriculture. In the Division of Foods of this Bureau, there is a special laboratory for investigating the methods of preparation and purification of edible oils, fats, and waxes.

In the Division of Drugs of the same Bureau, laboratories were established 1 July 1908, as follows:

(1) A Drug Inspection Laboratory, for the examination of drugs sampled in connection with the enforcement of the Food and Drugs Act, excepting those for which special arrangement is made at the branch laboratories. This includes a general investigation of drug products, bought on the market, to determine their standard composition and adulterants.

(2) A Synthetic Products Laboratory, to investigate synthetic products and preparations containing them, develop methods for the analysis of organic synthesis, and study the preparation of organic compounds and their analysis.

(3) An Essential Oils Laboratory, to investigate the essential oils and products in the manufacture of which the same are used. This necessitates studies relative to the chemical constitution and physical character of essential oils, the development of methods of analysis, and the improvement of those now existing; also the study of analytical processes for the examination of products containing essential oils.

(4) A Pharmacological Laboratory, to investigate the pharmacological action of drug products under the Food and Drugs Act. This includes a study of the physiological and pathological effects produced on animals by the medicinal substances which enter into the compositions of commercial drug products and by the derivatives and preparations of the same. See PHARMACOPŒIA, REVISION OF.

There is also a Miscellaneous Division in the Bureau of Chemistry, the principal lines of work of which are the examination and study of waters, cattle foods, forage crops, grains, insecticides and fungicides, trade wastes, and certain hygenic problems.

The Bureau of Chemistry publishes a great many bulletins and circulars, a list of which can be obtained by application to the Department of Agriculture.

In the several States, legislation is tending toward uniformity with the National Food and Drugs Act. The following State laws are typical. At the time of this publication, the States not mentioned below had no laws printed for general distribution, though in all the States food and drug legislation now exists and is increasing in volume.

Alabama.— This State has a special act relating to the packing, branding, and weight of packages of corn meal.

Arkansas.— The Arkansas Food and Drugs Acts, 28 May 1907, is administered by the State Commissioners (Board) of Health, whose duty is to examine specimems of foods or drugs which may be offered for sale in violation of the act. This Board reports its findings to the Commissioner of Mines, Manufactures, and Agriculture, who prosecutes offenders. The Board does not undertake to make special or individual decisions or rulings, nor to pass upon the form or style of particular labels.

California.— Here, the State Board of Health, on satisfactory evidence of violation of the provisions of the General Food Laws, respecting the adulteration or misbranding of foods, reports such facts to the district-attorney of the county where the law is violated, after a hearing, and the district-attorney prosecutes. The laws of this State are strong in their application to dairy products and wines especially. It is unlawful for any person "to produce, manufacture or prepare for sale, or to sell, or offer for sale, or have on hand for sale, any milk or product of milk to which has been added, or that may contain, any compound of boron, salicylic, acid, formaldehyde, or other chemical or substance for the purpose of preventing or delaying fermentation." Likewise, it is unlawful to produce, etc., any milk, cream, or condensed milk to which any coloring matter has been added by any person, or to which any gelatin or other substance has been added to increase its consistency, or make it appear richer; but it is not unlawful to use harmless coloring matter and common salt in butter and cheese. Pure wine in California is defined as in the laws of the United States relating to the fortification of pure sweet wines. A uniform wine nomenclature is in force, consisting of the use of the prefix "Cal" or "Cala" to the name of any kind, type, or abbreviation of name of wine; as, for example, "Calclaret," "Calburgundy," "Calariesling," etc., in stamping or labeling.

Colorado. — Here no article shall be deemed unbranded or adulterated within the provisions of the General Food Laws, "when intended for export to any foreign country and prepared, or packed, according to the specifications or directions, of the foreign purchaser, when no substance is used in the preparation or packing, thereof in conflict with the laws of such foreign country to which said article is intended to be shipped; but if such article shall be in fact sold, or exposed for sale, or delivered, or given away, or shipped or offered for shipment, for use or consumption within this State, then this provision shall not exempt said article from the operation of any of the provisions of this act." But the same section also provides that any such article must be in the original package and subject to interstate commerce under the federal jurisdiction. Colorado has a strong enactment prohibiting the sale of tainted or diseased meat. It prohibits preservatives and artificial coloring matter in sausage, except such as may be allowed by the United States Department of Agriculture; and it provides for inspection of canning and similiar establishments, excepting those where the United States Department of Agriculture maintains regular inspection.

Connecticut. — This State has given especial attention to dairy laws. It has followed many of the food inspection regulations and decisions of the Federal Department of Agriculture; and provides minute instructions for labeling and branding foods and drugs of all kinds. Specific regulations relate to compounds, imitations, or blends; waste materials; coloring, powdering, coating, and staining; the use of sugar in canned goods; mixed flour; the labeling of sardines; mixtures of cane and maple syrup; and the quantity of alcohol in drug products.

Delaware. — The adulteration of food and drugs is prohibited within the meaning of the law of this State, with the following exemptions: "(1) Where the order calls for an article of food or drug inferior to such standard and such difference is made known at the time; (2) where the article of food or drug is mixed with any matter or ingredient not injurious to health and not intended fraudulently to increase its bulk, weight, or measure, or conceal its inferior quality, if at the time such article is delivered to the purchaser, it is made known to him that such article of food or drug is so mixed." Foods must be labeled in compliance with Federal laws. The standard measure of milk and cream is specified as 57.75 cubic inches to the quart.

District of Columbia. — Weights and measures have special regulation, as in many of the States. The prevention of the sale of unwholesome food and the distribution of medicinal and poisonous substances is regulated by the Health Department.

Florida. — An elaborate schedule of standards of purity for food products is in force, as well as a General Food and Drugs Act. These standards are based upon data representing materials produced under American conditions and manufactured by American processes, or representing such varieties of foreign articles as are chiefly imported for American use. A departure of the article above the maximum or below the minimum limit prescribed is evidence that it is inferior or of abnormal quality. The schedule of standards is published by the State Department of Agriculture, at Tallahassee. The Pure Food Law of Florida was amended in 1909.

Georgia. — Bulletin No. 51, published by the Commissioner of Agriculture, in 1910, contains the rules and regulations of this State, as amended, relating to foods and drugs. It contains also a report on all foods and drugs inspected and analyzed from 1 June 1908, to 1 June 1910, including the names of manufacturers and dealers. Particular attention has been given to the sale of damaged corn, which produces the disease pellagra. The standards of purity of foods and drugs of the United States Department of Agriculture are the official standards of Georgia. The standards for lard, mixed edible fats, and cotton-seed oils, however, are defined by the Georgia law.

Hawaii. — The sale of intoxicating liquors that are adulterated is prohibited.

Idaho. — Bulletin No. 5 of the Board of Health, published in Oct. 1909, gives the food and drug standards of this State. All animal and vegetable products and beverages are standardized. Slaughter houses, creameries, and dairies are subject to careful regulation; and there are general regulations in regard to labeling, branding, adulteration, cold storage, imitations, etc.

Illinois. — A State Food Commissioner looks after the enforcement of the laws relating to adulterated and unbranded foods. Standards of purity and strength have been fixed for only a few articles in the act iself. The making or selling of adulterated spirituous, malt or vinous liquors is prohibited; also the sale of unclean or unwholesome dairy products and meats. A board of live-stock commissioners make, by the State veterinarian or a live-stock inspector, an examination of animals which they believe to be afflicted with any contagious or infectious disease, which would render the carcasses unfit for human food, and have power to confiscate and kill such animals.

Indiana. — The State Board of Health regulates the enforcement of the Pure Food Laws of this State which were first enacted in 1907, following the Federal statute. The Sanitary Food Law of 1909 provides for the sanitation of bakeries, canneries, packing houses, slaughter-houses, dairies, creameries, cheese factories, confectioneries, restaurants, hotels, meat markets, and all others food-producing establishments, and vehicles in which food is placed for transportation. Section 8 of this law provides that "No employer shall require, permit, or suffer any person to work, nor shall any person work, in a building, room, basement, cellar, or vehicle occupied or used for the production, preparation, manufacture, packing, storage, sale, distribution, and transportation of food, who is afflicted with any infectious or contagious disease. The law specifically prohibits the use of any arsenic, formaldehyde, or antiseptic injurious to health. The Board of Health authorizes the issuing of letters or orders by the State Food and Drug Commissioner, relating to such subjects as bleached flour, alum in pickles, sidewalk display of food stuffs, sausages with cereal added, etc. These are for the guidance of the trade.

Iowa. — A ruling under the Pure Food Laws of this State, points out that this State law "cannot touch the shipment or sale of foods across the State line, and that for this reason, the manufacturer without the State is perfectly safe, so far as prosecutions are concerned, in sending into this State goods that do not comply with the Iowa law." The National and State laws are quite different in their labeling provisions, and goods sold in this State must bear the labels required by the State law. The two laws are nearly alike in regard to prohibition of ingredients, such as chemical preservatives, harmful colors and flavors, and similar adulterations which are prohibited by both laws. In the case of goods which, to be legally sold, require specific form of labels, the provisions of the two laws are different, and the dealer who buys to sell again inside this State cannot rely upon the National guaranty for his labeling under the Iowa statute. The laws of Iowa are strong in regard to dairy products; in standards fixed for various kinds of vinegar are also notably complete.

Kansas. — The Food and Drug Law of this State is almost an exact copy of the Federal law, the only difference as applied to foods being that in Section 6, under the definition of food, as used in this law, are added the words "or in the preparation of food." These added words are meant to cover all condiments, flavors, extracts, baking powders, and such other articles as enter into the preparation of food, which is not clearly set forth in the national law. In Section 7, under "Foods," the word "tainted" is inserted in the Kansas law, but does not appear in the national law. This is for the purpose of covering certain unwholesome products that may not be decomposed in the strictest sense of the word, but which may be tainted with gases or ptomaines. Also, in Section 8, the word "arsenic" appears in the Kansas law, but not in the national law. The State Board of Health enforces the law under rules and regulations.

Kentucky. — The Director of the Agricultural Experiment Station makes analysis of samples of food or drugs which are manufactured or on sale in the State, or are suspected by the Board of Health or Board of Pharmacy of being adulterated or misbranded. He fixes standards of purity, quality, or strength when such standards are necessary, or are not fixed by statute. The standards of the United States Department of Agriculture are followed wherever possible.

Louisiana. — The food and drug regulations of the Louisiana Board of Health have the force of law. They are a lengthy detailed schedule of standards in connection with a general law, very nearly the same as the National Pure Food Law.

Maine. — The general food laws of 1907 closely follow the National Pure Food Law. Pure milk and water are protected by special legislation. Lobster meat must be sold in the shell, and no person shall buy, sell, give away, or expose for sale or possess for any purpose any lobster less than 4¾ inches in length, alive or dead, cooked or uncooked.

Maryland. — The National Pure Food Law is followed closely here also, and is enforced by rules and regulations of the State Board of Health.

Massachusetts. — Laws relating to labeling are well defined. The manufacture and sale of cocaine and articles containing it are prohibited. Sellers of oleomargarine are licensed, but the possession or sale of imitation butter is prohibited. The sale of candy containing more than 1 per cent alcohol to a person under 16 years of age is prohibited. Various other articles are the subject of special enactment, such as vinegar, meats, dairy products, and fish. Monthly bulletins are issued by the State Board of Health showing results of inspections.

Michigan. — A Dairy and Food Commissioner directs the enforcement of the laws prohibiting and aiming to prevent adulteration, misbranding, fraud and deception in the manufacture and sale of articles of food and drink, and drugs. Several public acts refer specifically to various articles, including buckwheat flour, vinegar, renovated butter, corn syrup, ice-cream, etc. The law is published with a digest of rulings on some of these articles.

Minnesota.— The laws here are original and are both general in terms and specific in application. Various articles of food have received special enactment for the protection of the public against impurity, imitation, and fraud. A distinction must be made in labeling, for example, between pure honey and honey substitute, and between raw linseed oil and boiled linseed oil. The sale of the veal of calves killed when less than four weeks old is prohibited. There is a strong act relating to the inspection of canneries, and establishing a grade for canned fruits and vegetables. Various rulings and regulations define the standards and methods of labeling of other articles.

Mississippi.— A pure food law was passed here in 1910, following closely the Federal statute. The State chemist is charged with its enforcement.

Missouri.— The definitions of adulteration and misbranding, and provisions relating to exemption under guaranty, inspection, prosecution, etc., are the features of this law, as in nearly all the States. The United States standards of purity have been adopted. There is a special act relating to the inspection of apiaries to detect diseases among honey bees. There is also a Bureau of Dairying. The Department of Food and Drug Inspection has issued a handbook of the laws, which are both general and special, with rules and regulations, standards for foods and liquors, notes and comments.

Montana.— The general food laws are brief. The purity of the water supply is protected by a strong special statute.

Nebraska.— Here, in addition to a general food law, the subject of dairies and dairy products has received special attention.

Nevada.— Nevada passed a pure food law in 1909, but it is not published in pamphlet form. There is an earlier statute (1903) protecting the water supply.

New Hampshire.— The Food and Drugs Act (1907) here is, with one or two exceptions, like the National Act, and there is coöperation of action between the States and Federal authorities. The State Board of Health issued a sanitary bulletin under date of Oct. 1907, containing the pure food and drug laws of the State. It is made up of various separate statutes passed from 1895 to 1907, inclusive, relating to candy, vinegar, dairy products, etc., and also the general act with the rules and regulations for enforcing it. Concerning the form of guaranty, a special notice is given to the public as follows: «For self-protection, every dealer in New Hampshire should demand of the manufacturer or jobber a guaranty that the food comply with the New Hampshire laws; and, further, the foods should be so marked, upon their receipt, that he may be able to identify, conclusively, the vendor, else he will be deprived of the protection provided for in the guaranty.» It is also suggested that the date of purchase be marked upon the foods secured under each invoice, and the care be taken to keep the articles in precisely the same condition as when received.

New Jersey.— The Board of Health publishes a pamphlet of the important acts relating to the sale or distribution of food or drugs. The National rules and regulations and food inspection decisions, in so far as they are applicable to the Food Law of their State (Revision of 1907) are regarded as indicating the policy of the Board with respect to the enforcement of the act. The act contains several distinct prohibitions relating to the manufacture and sale of various articles. The laws of 1886, 1887, and 1895, relating to imitation dairy products, are notably strong; also the laws of 1910 relating to the preservation of clams and oysters, and the operation of slaughter houses. The Board enforces an elaborate schedule of food standards; vinegar and bread being the subject of special enactments.

New York.— The Commissioner of Agriculture looks after the enforcement of the laws relating to pure foods. Bread, dairy products, adulterated vinegar, feed for animals, diseased animals, apples, pears, peaches and quinces, and maple sugar are the subjects of special enactment; but the laws relating to adulteration or misbranding of food and food products rest upon two brief sections following the definitions of the Federal statutes in regard to confectionery in particular and foods in general. The laws of 1893, as amended in 1907, relating to unclean receptacles and places for keeping milk are especially strong.

North Carolina.—The National Pure Food Law is closely followed throughout.

North Dakota.— The general food law defines the adulterating and misbranding of foods and beverages, specifying exceptions in the case of candies and chocolates, and baking powders. The State law of 1907 affecting dairy products, enforced by a Dairy Commissioner, is an important feature. In Bulletin 112 of the United States Department of Agriculture, containing the food legislation of the United States for the year ending 30 June 1907, is a schedule of suggestions to those who would comply with the pure food laws of North Dakota. The State itself does not furnish its food laws in pamphlet form; they are found in Chapters 195 to 198, Laws of 1907, and Chapters 188 and 189, Laws of 1909.

Ohio.— The laws, decisions, and reports relating to pure foods and medicines in this State are notably full. They are executed under the supervision of a State Dairy and Food Commissioner; and printed in his reports for 1908 and 1909, a book of the laws (1910), and a bulletin of patent and proprietary medicines. Vinegar, wines and liquors, dairy products, veal, candy, feed, maple sugar and syrup, canned products, and linseed oil have special provisions, in addition to the general laws. Commissioner Dunlap stated in his report of 1908, «Publicity is a great help in the enforcement of the food and drug laws. A small fine is easily paid and soon forgotten, but a public condemnation of a certain brand of foods not only affects present dividends, but is very likely to affect those of the future, and, in some cases, drives the dishonest manufacturer entirely out of business. While publicity is a powerful weapon to the commissioner, it is one which should be used with great care and judgment, for a single mistake might ruin a legitimate and worthy industry."

Oklahoma.— A Board of Health, having Food and Drug Inspection as part of its duties publishes a digest of the laws and rules under which it operates. There are special provisions relating to bakeries, sidewalk and floor displays, and slaughter houses; and rules and regulations for the enforcement of House Bill No. 404 (approved 20 March 1909) regulating the manufacture and sale of food, drugs, and medicine. The food laws of 1907-08 of this State are set out at length in Bulletin 121 of the United States Department of Agriculture. Bread, confectionery, dairy products, flavoring extracts, flour, lard, preservatives, spices, and condiments, are specially provided for.

Oregon.— The food laws of this State (1907) are not published in pamphlet form, except in Bulletin 121 of the United State Department of Agriculture. The provisions regarding the licensing of fish canners, the duties of the Fish Warden, the branding of fruit boxes, and the inspection of orchards and packing houses, are printed in full.

Pennsylvania.— The Dairy and Food Division of the Department of Agriculture publishes a law bulletin, containing State's Pure Food Act of 1909, and many special acts, together with a digest of numerous decisions of the courts regarding them. There are separate acts relating to milk and cream, non-alcoholic drinks, ice-cream, fresh eggs, lard, vinegar, cheese, fruit syrup, oleomargarine, renovated or process butter, and fresh meat, poultry, game, and fish. There are also rules and regulations issued by the Commissioner, relating to other articles of food.

Philippine Islands.— Here the United States Food and Drugs Act, 30 June 1906, is adopted *in toto*, excepting that, instead of the United States Secretary of the Treasury, the Secretary of Agriculture and the Secretary of Commerce and Labor making the rules and regulations to carry out the provisions of the act, as in the Federal law, this duty devolves upon the Insular Collector of Customs, the Director of Health, and the Collector of Internal Revenue of the Islands.

Porto Rico.— The Director of Health, Charities, and Corrections is authorized to determine whether refrigerated meat may or may not be supplied to institutions under his direction.

Rhode Island.— This State has a pure food law closely following the Federal Act, and general laws relating to milk, beef, and pork, infectious and contagious diseases, and "concentrated commercial feeding stuffs."

South Carolina.— The definitions contained in the National Act are followed here in regard to adulteration and misbranding, labeling and guaranty. A special act protects the water supply.

South Dakota.— The food and drug laws of this State, compiled to the close of the legislative session of 1909, are published in pamphlet form by the Food and Drug Commissioner. The pure food law is the same as the Federal statute, and the National rules and regulations for enforcing it have been adopted with additions by the Commissioner. Forms of labels are given, and rulings of the Commissioner on intoxicating liquors. A special law relates to dairy products, and another presents a schedule of food standards.

Tennessee.— The Federal law is followed here. Standards of dairy products are established by a special act.

Texas.— The Federal law is followed here by the General Law of 23 March 1907. In addition there are separate acts relating to alcoholic beverages, baking powder, cider, coffee, confectionery, dairy products, extracts, fish, flour, honey, lard, meat, preserved fruit and vegetables, syrups, spices and condiments, and vinegar. These are published in Bulletin 112, of the United States Department of Agriculture.

Utah.— The same class of legislation was enacted in this State, on 25 March 1907, as that enacted in Texas two days before. Dairy products and meats have received large consideration. An earlier law (1905) relates to renovated butter.

Vermont.— A complete schedule of food standards, for both animal and vegetable products (the latter including beverages of all kinds), and for salt, and baking powders, is published in pamphlet form with the general law relating to pure food and drugs. The law is reproduced from the Public Statutes, Chapter 226, as amended by Acts of 1908, and distributed by the State Board of Health. Both the law itself, and the rules and regulations for its enforcement are original in form and statement, although the effect is the same as that of the Federal act.

Virginia.— The pure food law of this State directs the Dairy and Food Commissioner, with the approval of the Commissioner and Board of Agriculture and Immigration to fix and publish standards of food products, but provides that when standards have been fixed by the Secretary of Agriculture of the United States, they shall be accepted as standards for Virginia. Such standards are published by the Virginia Department of Agriculture; also, the general law of 1910 relating to "concentrated commercial feeding stuffs," the stock and poultry foods law, and sanitary rules and regulations.

Washington.— The Federal law is followed here, and enforced by a Dairy and Food Commissioner. There is a special statute relating to dairy products, and rules and regulations affecting other products.

West Virginia.— A condensed version of the Federal act was passed here in 1907; and a special provision relating to the slaughtering of young calves. They are published in Bulletin 112 of the United States Department of Agriculture.

Wisconsin.— A Dairy and Food Commissioner publishes the dairy and food laws, and the recisions of the courts relating thereto. They were first enacted in 1898, and were amended and added to in 1907 and 1909. The law of 1909, taking effect 1 Jan. 1910, and prescribing legal definitions and standards for a large number of food products, is one of the most important food laws ever enacted by a State legislature. As stated by the Commissioner in his introduction, "It provides a 'square deal' for honest manufacturers, jobbers, retailers and consumers. It removes the serious defects from the Wisconsin dairy and food laws which Hon. John C. Spooner, on the floor of the

United States Senate, pointed out as existing in the National Food Law and which he argued with much force might be a menace to its validity." There are important chapters also referring to the sanitary production and distribution of food.

Wyoming.— A Dairy, Food, and Oil Commissioner looks after the enforcement of the brief laws of this State relating to pure foods and beverages. These laws bear dates of 1903, 1905, and 1907. They appear in Bulletin 112, already mentioned.

Foods, Substitutions in.— There are two kinds of food adulterations: one harmful; the other not necessarily injurious, yet honest dealers in food compounds are endeavoring to suppress the latter, owing to the fact that it is a commercial misrepresentation. The preservation and "devilling" of meat and poultry by the canners gives opportunity for this practice. Although large purchasers of chickens and other poultry, comparatively little of this meat finds its way to market under its proper designation. As is shown by the report on "Foods and Food Adulterants," issued by the U. S. Department of Agriculture, cans of so-called chicken and turkey, are often filled with a large admixture of veal and pork, while the meat of the fowl, finally finds its way to cans that bear the label of "pheasant," "woodcock," etc. "Curry of Chicken," when canned has been found to be chiefly beef, a meat which also masquerades as "Wild Bear," after passing through the hands of the canner.

The imitation of *pâté de foies gras* is a trick to which both canners and chefs so commonly resort that it is now almost impossible to determine whether it is the fattened goose livers or a cleverly compounded substitute. In the canning of goose liver, pigs' liver is frequently introduced, and it is not uncommon for canners to use a certain amount of beefs' liver.

The practice of substituting horse flesh for beef in canning became so common prior to 1911 that boards of health of several States issued orders forbidding the canning of meats by concerns engaged in a business requiring the purchase of old horses. The use of soap-powders in the preparation of merangues for pastry was also officially prohibited by health authorities. The bulk of the caviare sold in the United States has never passed the customs officials, but is made in New Jersey and the New England States, where the roes of other large fish are used as a substitute for those of the sturgeon.

Foods for the Sick. See SICK, FOODS FOR.

Fool. See JESTER.

Fool of Quality, The, a curious novel by Henry Brooke, published originally in five volumes (1760–77). It was considered of such spiritual value by John Wesley, the founder of Methodism, that he prepared a special edition of it for the use of his followers. Toward the close of the book its mysticism becomes exceedingly exalted and visionary, suggesting the author's acquaintance with the teachings of the German mystic, Jacob Boehme.

Fool's Errand, A, a story by Albion W. Tourgee, published in 1879. It is the first of a series dealing mainly with events connected with the Civil War. "The Fool" is Comfort Servosse, a Union colonel, who removes from Michigan to a southern plantation after peace is declared. The story of his reception there and the difficulties encountered, arising out of old prejudices upon the one hand and his own training and convictions upon the other, is told with much detail and strong local coloring.

Fools, Feast of. Festivals, under this name were regularly celebrated, from the 5th to the 16th century, in several countries of Europe, by the clergy and laity, with the most absurd ceremonies, and form one of the strangest phenomena in the history of mankind. Among the heathen festivals which the Christians could not easily abolish, were the Saturnalia, which, in the confusion of all distinctions of ranks, and in extravagance of merriment, exceeded the gayest carnivals. The feast of fools, among Christians, was an imitation of the Saturnalia, and, like this, was celebrated in December. The chief celebration fell upon the day of the Innocents, or upon New Year's Day; but the feast continued from Christmas to the last Sunday of Epiphany. At first only the boys of the choir and young sacristans played the principal part in them; but afterward all the inferior servants of the Church, and even laymen, engaged in them, while the bishop, or the highest clergyman of the place, with the canons, formed the audience. The young people, who played the chief parts, chose from among their own number a bishop or archbishop of fools, or of unreason, as he was called, and consecrated him, with many ridiculous ceremonies, in the chief church of the place. This officer then took the usual seat of the bishop, and caused high mass to be said, unless he preferred to read it himself, and to give his blessing to the people, which was done with the most ridiculous ceremonies. During this time the rest of the performers, dressed in different kinds of masks and disguises, engaged in indecent songs and dances, and practised all possible follies in the church. Except from their association with the Saturnalia nothing is known of the origin of these extravagancies, which appear to have been very ancient. The most celebrated, and probably one of the most ancient of these festivals, was held in the city of Sens, in France. By an ordinance in 1245, intended to abolish it, it is alluded to as a very ancient celebration. So general was the custom of these celebrations in France, that it is said there were few towns at the end of the 17th or even as late as the middle of the 18th century, in which associations did not exist. Similar antics seem to have been played in other countries, as Germany, England, and Scotland, but it is to be hoped that the height of profanity reached in some of the extant liturgies and rubrics was not commonly attained in these fooleries. The *fête des fous* at Sens was suppressed in 1547. These fêtes were frequently prohibited, but until the Reformation period, when they were considered dangerous by the ecclesiastical authorities, they were commonly tolerated. To account for these celebrations, so opposed to all our ideas of religion, decency, and common sense, we must transfer ourselves to times when men combined, with childish simplicity, the most ridiculous with the noblest subjects, and often with less injury than we should suppose to the latter. Similarly, grotesque or indecent figures are to be seen among the sculptures of old Gothic churches, and may not unfrequently be detected in the work of the large initial letters of the breviaries and religious books of this period.

Fool's Parsley. See Dog Parsley.

Foot, Solomon, American statesman: b. Cornwall, Vt., 19 Nov. 1802; d. 1866. He was graduated at Middlebury College in 1826 and in 1831 was admitted to the bar, and settled in Rutland. For several terms he represented the town of Rutland in the Vermont legislature, and in 1842 and again in 1844 was elected a representative in Congress. From 1851 till his death he sat in the United States Senate where he made many important speeches, and bore a conspicuous part in the Lecompton debate of 1858.

Foot. In the human foot the bony structure is made up of three divisions, the tarsus, metatarsus, and phalanges. Seven bones form the tarsus; the os calcis or heel-bone, the largest and strongest of all, carries the principal part of the body's weight. On its posterior surface the large muscles of the calf find their attachment through the tendon Achillis. Half in front of the os calcis and superimposed upon it is the next largest bone, the astragalus. This bone bears directly the weight of the body through the large leg-bone, the tibia, resting on the upper surface. On the outer side in front of these two bones is the cuboid, and on the inner side the scaphoid or navicular bone. In front of the scaphoid there are the three small cuneiform bones, internal, middle, and external. These three bones with the cuboid form articulations with the next row or division. The metatarsus is formed of five so-called long bones; that is, each bone has a shaft and articulating extremities. To each of these is joined one of the next division or phalanges. These are also long bones, the great toe made up of two bones, and the others of three each. Strong ligaments bind these bones to one another in such a way as to form and maintain an arch from before backward, and somewhat from side to side, the points of contact with the ground being only with the os calcis behind and the metatarsus and phalanges in front — the so-called ball of the foot. By this arrangement shock is transmitted through an arch or spring, pads at these two points also further eliminating jars. The sole of the foot is also covered with small muscles, which move the toes, and tendons that flex the toes and extend the foot on the ankle. Across the dorsum or instep pass the flattened tendons that flex the foot and extend the toes. The chief artery to the sole comes down on the inner side of the heel, passing across to the outer side, then arching across to the inner side again, giving off branches to the toes. On the dorsum the main artery comes to the surface at the instep and forms an arch of supply to the toes. The nerves on both surfaces closely follow the arteries.

Among the lower animals, monkeys have feet that approach nearest to those of the human. The separation of the great toe, in a way corresponding to the thumb, and the absence of the arch are the points of difference. In many of the animals, as in the cat tribe, there is a greater or less tendency toward a rudimentary inner toe, and an increase of the function of the ball of the foot, with a lessening of the importance of the heel. In the cattle and equines the toes are fewer, and the nails or claws become converted into hoofs. The horse walks on the end of his single digit.

In measure of length, the name foot is derived from the length of the human foot, containing 12 linear inches. Square foot is a square whose side is one foot, and is therefore equal to 144 square inches. Cubic foot is a cube whose side is 1 foot, and the cube contains 1,728 cubic inches. The foot is a common measure in various countries, but its dimensions often vary somewhat. In poetry, a measure consisting of a variety of syllables, two, three, or four, in combinations of long and short, or accented and unaccented syllables. The number of possible varieties of feet is reckoned at 28. See Rhythm.

Foot and Mouth Disease. See Murrain.

Foot-pound, the unit of work or of energy that is commonly used in engineering calculations in England and the United States. It is defined as the quantity of work expended in raising a weight of one pound through a vertical distance of one foot. As the attraction of the earth for a pound of matter varies somewhat in different latitudes and at different heights above the sea, the foot-pound is subject to corresponding variations as we pass from one locality to another. To give the unit greater definiteness it has been proposed to define it as the quantity of work done in raising one pound of matter through a vertical distance of one foot, at the level of the sea in latitude 45°. This definition differs from the ordinary one, it will be observed, solely by specifying the locality at which the experiment is supposed to be performed. See Units.

Foot-rot, a disease in the feet of sheep, the more common form of which is an inordinate growth of hoof, which at the toe, or round the margin, becomes turned down, cracked, or torn, thus affording lodgment for sand and dirt. In the second form of the disease the foot becomes hot, tender, and swollen, with ulcerations between the toes, followed by the sprouting of proud flesh. The inflammation is due to suppression of the secretion of the gland between the toes, usually the result of standing too much in wet ground. The best remedy is to pare away the diseased and ragged parts of the hoof, thoroughly applying a lotion made by dissolving one pound of blue vitriol in a quart of water, and keeping the animal always in a dry place.

Foot-wall. In mining language, the foot-wall of a vein is the rock boundary of its lower side, the side on which a miner would stand in breaking down the ore. The term is also used in speaking of a fault or rock dislocation, the foot-wall of a fault being formed by the edges of the rock strata that underlie the plane of displacement. See Fault; Mining; Ore Deposit.

Foota-Jallon. See Futa-Jallon.

Football in America, as in England, is of different varieties, but by far the most prominent is the game played in the colleges. This type is the outgrowth of the English Rugby and still possesses points of similarity to the game from which it was derived. Association football is played in and around some of the mill towns where the foreign population predominates, and previous to 1870 a mongrel kind of football made up of a combination of Association and Rugby had some vogue, and was the original form of the sport in America

The type, however, known as American football suggests now only one variety and that is the one mentioned above as prevailing in colleges and universities. This sport draws to each of its chief annual contests from 25,000 to 40,000 spectators. During its season, which consists of October and November, it temporarily eclipses all other athletics in interest. For this reason it is the money maker in college athletics, in a great number of universities the receipts from the football contests practically supporting the other athletic branches throughout the year.

This sport, developed as it now stands, was originally introduced into American colleges by Harvard, whose team, having visited Canada and played under the Canadian rules, became enamored of the style of the English Rugby, and, although in 1875, as a matter of consideration for her ancient rival, Yale, Harvard agreed to compromise between what was then known as American football and English Rugby, in the next year, 1876, both teams adopted the Rugby Union rules as they stood at that day. Unfortunately for the peace of mind of the legislators, but probably fortunately in another way, in that the final result was the development of still another distinct type of football, there were no traditions in America regarding the English Rugby code and what was forbidden by letter was accepted as barred, whereas anything that was not thus distinctly prohibited the American player thought was perfectly legitimate. Contentions arose over the interpretation of the rules and these discussions led to conventions, and, in the settlement of the problems arising, the rules rapidly multiplied, until in a few years there were more than twice the original number. While this was happening, some of the old English rules apparently became dead letters and were, therefore, dropped. When captains and players attended any of these conventions it was only human that they should contend for possible advantages for their own teams rather than for the improvement of the game as a sport and this led to the appointment of an advisory committee of graduates. In their hands was placed the matter of rules to this extent, that yearly they met and recommended changes which were then submitted to an intercollegiate association for discussion and usually for approval. This lasted as long as there was an intercollegiate association or league of colleges indulging in football. This league finally dissolved and for the season following there were two codes of rules in existence adopted by two different sets of universities. This was wholly unsatisfactory and led to the intervention of the University Athletic Club of New York. This club selected football enthusiasts and asked from them a recommendation as to a code of rules. These gentlemen met and framed such a code, which was then adopted by the various colleges throughout the country. This method of procedure lasted for several years, even after the dissolution of the University Athletic Club, and it is from this body that the football rules emanated, until at the end of the season of 1905 a general conference of colleges not represented upon the Rules Committee appointed seven delegates with whom the old committee amalgamated, forming a new committee of 14. This committee made the rules for 1906 and introduced what was known as the 10-yard rule, which practically did away with the old mass plays that had caused the game to become too contracted.

As for a brief description of the game and the way in which it is played, the following gives the main points:

The game is played on a field rectangular in shape, 160 feet wide and 330 feet long. The outline of this field is made by heavy white lines marked, as are the lines in a tennis court, with lime. This field is also traversed by transverse lines five yards apart marked for the convenience of the referee in judging the distance gained or lost by either side. In addition to these transverse lines the field is marked by longitudinal lines also five yards apart in order to assist the referee once more in measuring distance rapidly with his eye. This latter marking was rendered necessary by a rule providing that within that section of the field the quarterback may run with the ball provided he goes a certain distance out, that is, toward the side line, from the man who puts the ball in play in the centre. This same five yard distance governs a forward pass. The lines which mark the ends of the field are called goal lines, and in the middle of each is a goal made by erecting two posts 18 feet, 6 inches apart with a cross bar 10 feet from the ground. The ball is a prolate spheroid in shape consisting of a rubber bladder in a leather cover.

The game is played by 11 men on a side, these 11 men being called a team. For the purpose of general distinction, although different formations are possible, the seven men who play in the forward line, that is on a line with the ball when it is put in play, are called the rushers, the men behind them the backs. The distinguishing terms for the men in the line are of interest. First there is the centre rusher, or centre, or snap-back, which term designates the man who stands in the middle of the line and usually puts the ball in play in a scrimmage. The men on his right and left are called guards, the men next beyond them towards the ends are called tackles and the two men on the ends of the line are called the ends. The man close behind the centre rusher is called the quarterback. The two men some feet behind him are called the half-backs and the fourth man behind the line is called the full-back. In executing various plays the men take up different positions on the field, but they are usually distinguished by their positions as above.

The game is started by placing the ball in the middle of the field and a man of the side in possession must then kick it at least 10 yards into the territory of the opponents, his own men being behind him when he kicks the ball and the opponents standing at least 10 yards back from the middle line of the field. The choice of goals and the possession of the ball having been determined by the toss of a coin, the side winning has the privilege of thus either kicking off or selecting either goal. When the ball is once kicked off any man who is on side, that is, between the ball and his own goal, may secure it and run with it and when he is thus running may be tackled by his opponents and brought to a stop. If he is thus tackled and stopped he calls «down» and the ball is placed on that spot for a scrimmage. When the ball is thus down the two teams line up opposite each other, the side with the ball endeavoring to protect its men so that one of the backs may be able to secure the ball and make a run with it, kick it, or pass it, while members of the opposing side are endeavoring to break through and stop this. The men of the side which has the ball in its possession may not use their hands or arms to obstruct their opponents, but may do this with the body only. The players of the side not in possession of the ball on the other hand are privileged to use their hands and arms to break through the ranks of their opponents. The man who has the ball in his possession, that is running with it, may use his hands and arms to ward off the opponents, but the rest of his side may not. The play thus continues by a succession of downs and runs interspersed with kicks, for a side may kick or pass the ball under certain limitations instead of running with it if they so desire.

In order to prevent a side holding the ball indefinitely without making progress there is a rule providing that in 3 attempts the side must advance the ball 10 yards or surrender it to the opponents. For this reason it is quite customary after two attempts, if the desired ground has not been gained, for the side in possession to kick the ball, thus transferring it to the possession of their opponents as far into the opponents' territory as possible. One forward pass is allowed to a scrimmage under certain restrictions, and a kicked ball striking the ground puts all the players of the kicker's side «on side,» otherwise a man who gets ahead of the ball when last touched by one of his own side behind him may not touch the ball. When the ball goes across the side line it is out of bounds and if it has gone out of bounds through being kicked, it belongs to the opponents, but if a man carries it out of bounds, in his possession, his own side has the right to it. The ball is brought back to the spot where it crossed the line and is put in play by the holder walking in a certain distance and putting it on the ground for a scrimmage as already described.

The game thus proceeds until the ball approaches one or the other goal line and here begins the question of generalship for scoring. If the ball be kicked by a drop kick over the cross bar of the opponent's goal it counts the side thus kicking it four points. If the ball be carried by the player of that side across his opponent's goal line or secured by him after it has been kicked across it scores a touch-down, which counts five points and also entitles the side making it to a try at goal. This is performed either by kicking the ball out to a player who catches it and makes a mark with his heel, the ball then being kicked from any point behind that mark, or being brought directly out by a player of the side which has touched it down and held on the ground for another of his side to kick. In either event if the touch-down be converted into a goal by the kicking of the ball over the cross bar it adds an additional point for this scoring.

There is one other possible means of scoring and that is when a side is pressed by the opponents, and, instead of the opponents securing the ball, the defenders of the side secure it and either kick, pass, or carry it across their own goal-line and touch it back behind their own goal. This entitles them to carry the ball out 25 yards for a kick. The opponents stand on the 25 yard line while this kick is made. This safety, however, as it is called, counts two points against the side making it.

The game is divided into 2 halves of 35 minutes each with a 10-minute intermission, and the side which has scored the greater number of points at the end of the full period of play wins the game.

American football, while it started from the English Rugby Union rules, has developed in many directions so that the game would not now be recognizable to an Englishman. The one thing that he would see that possibly reminded him of Rugby would be that occasionally a man runs in the open field with the ball. But the various formations and the tactics adopted would puzzle him exceedingly. Like the Rugby Union, however, there is some kicking in it, but far less than in the English Association. In the English scrimmage the two lines of forwards push until the ball pops out somewhere, whereas in the American scrimmage the man in the center who has possession of the ball snaps it out with his hand whenever he is ready to do so to the quarter-back who stands directly behind him and this man passes it to some other player of his own side. This enables the Americans to carry out their very elaborate system of plays because the ball can be absolutely directed at any time to any spot. So perfect has this development become that the quarter-back gives signals for the plays by means of which signals the entire team knows exactly what man is to receive the ball and where he is to run with it when he has received it. Thus the others may assist him very materially in making his gain. Some idea of the variety of plays can be gathered from the fact that teams can without difficulty execute no less than 40 or 50 plays, each distinct from the other. It is not difficult to imagine that with this highly developed form of attack a most thorough and well-studied plan of defense is equally necessary. It is also not difficult to understand that this development on both sides has brought about specialization in the work of various players so that almost every position on the field has a distinct line of duties which its incumbent must be able to perform with skill and accuracy. The signals are quite elaborate codes, devised for easy memorizing, but at the same time sufficiently intricate and bewildering as to render the liability of discovery by the opponents very small.

In the American game the quarter-back usually gives these signals, although the captain sometimes prefers to give them himself.

The history of the game in America as in England and elsewhere has been one of discussion and opposition, the latter coming from those who believe that the sport is too strenuous. Kingly edicts were issued in the old days in England and in the United States State legislatures have been asked at various times to forbid the pastime. Yet it has lived on. In America the game has had already three great epochs as it were. The first in the eighties when the «block game» was legislated out of existence, then in the early nineties when «momentum mass» plays were excised and finally in 1906 when the ten yard rule was adopted.

A widespread public sentiment was advanced in favor of such a change in the rules as might bring about more «open play,» and it was further felt by the committee and their advisers that the rules should be so modified and the powers of the officials so increased as to eliminate to the greatest possible extent unsportsmanlike tactics, and with these ends in view the committee decided upon the incorporation of two important changes. The first of these was the adoption of the 10-yard rule together with the forward pass and on side kick. The second general change was the incorporation of rules that in some cases greatly increased the penalty for unfair tactics, and in others did away with all excuses for indulgence in certain rough plays, at the same time providing for more efficient work by officials. To make sure that the wishes of the committee were carried out in this matter, the duties of the linesman were enlarged and he was made practically an assistant to the umpire and given absolute power to deal with certain classes of fouls. A second umpire was added. The American game thus has for its conduct four officials, the referee whose duties are principally related to the progress of the ball, the umpires who have charge as it were of the conduct of the players, the linesman who acts as an added umpire, at the same time assisting the referee in the matter of measurements and time keeping.

WALTER CAMP,
Yale University.

Foote, füt, **Andrew Hull**, American naval officer: b. New Haven, Conn., 12 Sept. 1806; d. 26 June 1863. He entered the navy as a midshipman in 1822, and in 1849-52 he was engaged in the suppression of the slave trade on the coast of Africa. In command of the China station in 1856, when the Chinese and English were at war, he exerted himself to protect American property, and was fired upon by the Celestials. His demand for an apology was refused and he stormed and captured four Chinese forts. In 1861 he commanded the expedition against Forts Henry and Donelson on the Tennessee and Cumberland rivers, and directed the attack on Island Number 10. In 1862 he was promoted rear-admiral. He wrote 'Africa and the American Flag' (1854).

Foote, Arthur, American composer: b. Salem, Mass., 5 March 1853. He was graduated at Harvard 1874, became a teacher of the piano and organist of the First Church in Boston and has devoted much time to composition, in which field he has been very successful, having published a cantata 'Hiawatha,' a trio in C major for piano, violin, and 'cello; suites for the orchestra; an overture, 'In the Mountains'; songs, and pianoforte pieces.

Foote, Henry Stuart, American statesman: b. Fauquier County, Va., 20 Sept. 1800; d. Nashville, Tenn., 20 May 1880. He was admitted to the bar in 1822; removed to Mississippi in 1826 and entered politics. In 1847 he was elected to the United States Senate, and in 1852 was elected governor of the State. He was a strong opponent of secession at the convention held at Knoxville, Tenn., in 1859, but when secession was an assured fact, he accepted an election to the Confederate Congress, where he opposed most of President Davis' measures.

Foote, Lucius Harwood, American diplomatist: b. Winfield, N. Y., 10 April 1826. He was educated at Knox College and at the Western Reserve University; went to California in 1853; and was admitted to the bar in 1856. He was a municipal judge in Sacramento 1856-60; and collector of the port of Sacramento 1861-5. He became adjutant-general of California in 1861, and was consul to Valparaiso, Chile, 1878-81. Appointed minister to Korea in 1882, he distinguished himself in the protection of Japanese and other foreigners in the nationalist revolt in Seoul in 1883, and received the thanks of the emperor of Japan, the Chinese government, and the emperor of Korea for his services. He resigned in 1884 and returned to California, where in 1890 he was made treasurer of the San Francisco Academy of Sciences. He has written 'Red Letter Day and Other Poems' (1882); 'On the Heights' (1887); etc.

Foote, Mary (HALLOCK), American novelist: b. Milton, N. Y., 19 Nov. 1847. In 1876 she was married to Arthur D. Foote, a mining engineer. She has published: 'The Led Horse Claim' (1883); 'John Bodewin's Testimony' (1886); 'The Last Assembly Ball' (1889); 'In Exile and Other Stories' (1894); 'The Chosen Valley'; 'Cœur d'Alène' (1894); 'The Cup of Trembling and Other Stories' (1895); 'The Little Fig Tree Stories' (1900); 'The Prodigal' (1900); 'The Desert and the Sown' (1902); 'A Touch of Sun and Other Stories' (1903); etc.

Foote, Samuel, English actor and playwright: b. Truro, England, 27 Jan. 1720: d. Dover, England, 21 Oct. 1777. From Oxford he turned his attention to the stage; tried tragic parts and failed; then began to give entertainments of a sort now familiar but then new, impersonating real and imaginary people and acting little farces by himself. He wrote many farces, the most notable being: 'The Minor' (1760), a skit at the Methodists; 'The Liar'; 'The Mayor of Garratt.'

Foote, Samuel Augustus, American statesmen: b. Cheshire, Conn., 8 Nov. 1780; d. there 15 Sept. 1846. He was graduated at Yale College in 1797; served in the legislature for many years; was member of Congress in 1819-21 and 1823-5; served one term in the United States Senate, was governor of Connecticut, and one of the presidential electors on the Clay and Frelinghuysen ticket in 1844. It was he who in 1829 introduced the bill «on the public lands» that occasioned the famous debate between Hayne and Webster.

Footmen, a collector's name for the small gray and yellowish moths of the family *Lithostidae*, which have simple antennæ, rather narrow fore wings, beneath which the broad hind wings are folded when at rest.

Foraging Ants, the large, powerful ants of the tropical American genus *Eciton,* which from time to time march in hosts across the country, with the precision of an army under the control of officers. These marching columns are composed almost wholly of workers, apparently directed by a larger, lighter-colored kind; and they search every inch of ground, rubbish-heap or thicket, searching for what they can eat and driving every living thing out of their way in terror. Several species exist, differing in various respects. One, for example, devotes its forays entirely to finding and robbing the homes of a smaller and very different ant (*Hypoclinea*), whose larvæ and pupæ it carries off, but lets the adults go free. Ordinarily no insect that can be caught is spared. These ants have no settled abode, but make nests in hollow stumps, or underground, and change them each season or oftener. Their colonies exhibit a high degree of organization, and contain five separate castes, instead of the three of ordinary ants. See ANTS, and the works referred to thereunder; and especially Belt, 'Naturalist in Nicaragua' (1888).

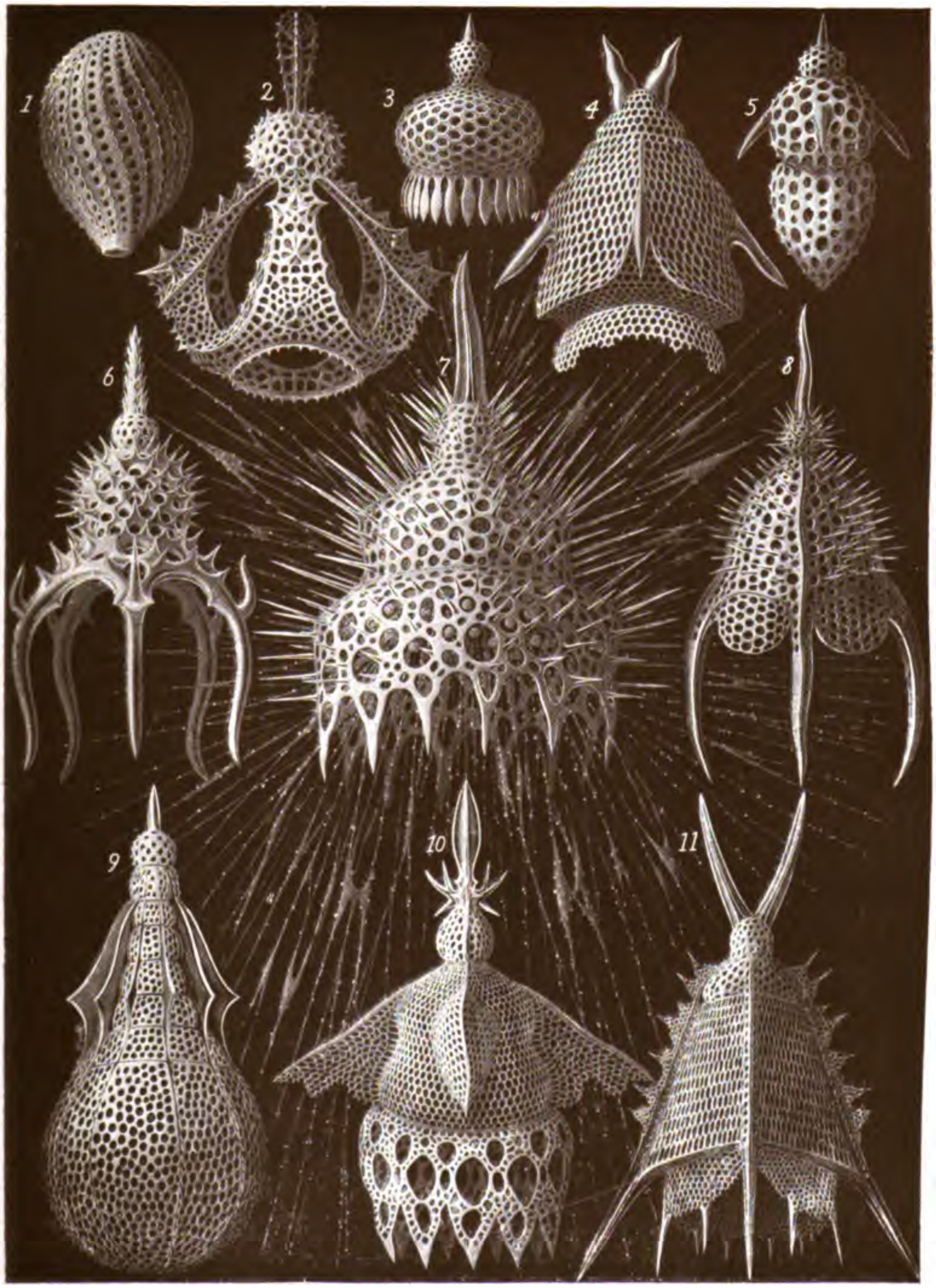
Foraker, Joseph Benson, American politician: b. near Rainsboro, Highland County, Ohio, 5 July 1846. He enlisted in the 89th Ohio infantry in 1862, participated in the battles of Missionary Ridge, Kenesaw Mountain, and Lookout Mountain and in Sherman's «march to the sea,» served on the staff of Gen. Slocum, and was mustered out in 1865 with the rank of first lieutenant and brevet captain. Subsequent to the War he studied for two years at the Ohio Wesleyan University, in 1869 was graduated from Cornell University, and in the same year was admitted to the bar at Cincinnati and there began the practice of law. In 1879 he was elected judge of the superior court of Cincinnati, from which post he resigned in 1882. He was Republican candidate for the governorship of Ohio in 1883, but was defeated by Hoadly, Democrat; was elected in 1885 and re-elected in 1887; and was again defeated in 1889, this time by Campbell. In 1896 he was elected United States senator to succeed Calvin S. Brice, and in 1902 re-elected. He was chairman of the Ohio Republican State conventions of 1886, 1890, 1896, and 1900; a delegate-at-large from Ohio to the national Republican conventions of 1884, 1888, 1892, 1896, and 1900, being chairman of the Ohio delegation in 1884 and 1888; and presented to the conventions of 1896 and 1900 the name of William McKinley for nomination to the Presidency. He attained the largest law practice in southern Ohio, and became well known in that State as a corporation attorney and a vigorous orator on political questions. His election to the Senate at once made him the Republican leader of Ohio. In the Senate he took a prominent part in the discussions connected with the Spanish-American war, of which he was a conspicuous advocate. His name has been mentioned for the Presidential nomination.

Foraminif'era, an order of animals in the phylum *Protozoa* and the class *Rhizopoda.* The body is contained within a calcareous test or shell, which is many chambered. It may be cylindrical or spiral, or it may tend to the pyramidal form. The outer surface presents a punctate or dotted appearance, produced by the presence of very numerous small apertures, or «foramina.» The chambers in some are perfectly distinct from others, though so aggregated as to form a compound shell; in others they are connected with a funnel-like tube. The texture of the shell in one group is porcelain-like, in another glassy. The inside of the shell has an extensile and contractile sarcode (protoplasm) of a reddish or yellow color, which streams through the openings and thinly covers the outside. Foraminifers are always of small size, and often microscopic. With the exception of *Gromia* and one or two related genera which occur both in fresh and salt water, they are exclusively marine and many dwell only in the abysses. Sometimes their shells constitute sea-sand. In the Atlantic, at a depth of 3,000 fathoms, there is an ooze composed almost entirely of *Globigerinæ,* which belong to this order. See GLOBOGERINA.

The exceedingly antique *Eozoon* (q.v.) of the Laurentian rocks, if organic, as is generally believed, was apparently a foraminifer. Forms more unequivocal, some of them very like recent species, occur in the Silurian, the Carboniferous, and other strata. They are found through all the Secondary Period, chalk (q.v.) being almost entirely composed of their cases. They increase in number and importance in the Tertiary. The flat, coin-shaped nummulites of the Middle Eocene form the principal bulk of great series of limestone rocks that furnish excellent building-stone. The type of the order has remained wonderfully constant from the earliest times till now.

Foran, Joseph Kearney, Canadian author: b. Aylmer, P. Q., 1857. Among his poems the best known are a 'Lament for Longfellow' and 'Indian Translations.' He is the author of two novels, 'Tom Ellis, a Story of the Northwest Rebellion,' and 'Simon, the Abenakis.' 'The Spirit of the Age' (1894); 'Poems and Canadian Lyrics' (1895).

Forbes, fôrbz, **Archibald,** English journalist and war correspondent: b. Morayshire 1838; d. London 30 March 1900. From 1859 till 1864 he served in the Royal Dragoons, but, abandoning the army for journalism, joined the staff of the *Daily News,* as war correspondent. In this capacity he accompanied the German army through the war of 1870–1, and a little later, in Paris, was present at the downfall of the Commune. He was in India during the 1874 famine, and shortly afterward the Carlist and other troubles kept him for a time in Spain. He accompanied the Prince of Wales on his Indian tour in 1875–6, and on returning described as an eye-witness the Servian war of 1876. In the following year he was with the Russians in their campaign against the Turks, being present at the battle of Plevna, and in 1878 he went to Cyprus. He was under fire during the Afghanistan campaign of 1878–9, next visited Mandalay, and then went to Zululand. He afterward devoted himself mainly to lecturing at home and in America and Australia. His chief publications are: 'My Experiences in the Franco-German War' (1872); 'Glimpses through the Cannon Smoke' (1880); 'Chinese Gordon' (1884); 'Souvenirs of Some Continents' (1885); 'William I. of Germany' (1888); 'Barracks, Bivouacs, and Battles' (1891); 'Havelock' (1891); 'Afghan Wars' (1892); 'Colin Campbell, Lord Clyde' (1895); 'Camps,



RHIZOPODS.

[1] Cyrtophormis spirall. [2] Clathrocanium reginae. [3] Anthocyrtium campanula. [4] Pterocorys rhinoceros
[5] Lithornitbium falco. [6] Alacorys Bismarckii. [7] Calocyclas monumentum. [8] Pterocanium trilohum.
[9] Stichophaena Ritteriana. [10] Dictyocodon Annasethe. [11] Artopilium elegans.

Quarters, and Casual Places' (1896); 'Memories and Studies of War and Peace' (1896); 'The Black Watch' (1896); 'Life of Napoleon III.' (1898).

Forbes, David, English geologist: b. Douglas, Isle of Man, 6 Sept. 1828; d. London 5 Dec. 1876. As a civil engineer he traveled all over the world, studying rock formations and fossils, and writing: 'On the Relations of the Silurian and Metamorphic Rocks of the South of Norway' (1855); 'On the Geology of Bolivia and Southern Peru' (1861); and kindred treatises.

Forbes, Duncan, Scottish jurist: b. near Inverness, Scotland, 10 Nov. 1685; d. 10 Dec. 1747. He studied at Paris, Utrecht, and Edinburgh, and rose, in 1737, to the rank of president of the Court of Session. It was mainly owing to his exertions that the rebellion of 1745 was prevented from spreading more widely among the clans; but so ungratefully was he treated by the government, that he was never able to obtain repayment of the various sums he had expended to uphold it. He was the author of: 'Thoughts on Religion'; the 'Culloden Papers'; etc.

Forbes, Edward, English naturalist: b. Douglas, Isle of Man, 12 Feb. 1815; d. Wardie, near Edinburgh, 18 Nov. 1854. He was a brother of David Forbes (q.v.). He became professor of botany in King's College, London, in 1843, and curator of the Geological Society; in 1851 professor of natural history in the School of Mines; and in 1853 he was elected to the chair of natural history in the University of Edinburgh. He did much to advance and systematize special departments of natural history, both by his own labors and by the stimulus which he imparted to his associates and pupils. His classification of the British star-fishes opened a new era in that branch of zoology; and his discovery that air-breathing mollusks lived at the period of the Purbeck beds rectified many erroneous hypotheses. Of his separate works, papers, and monographs upward of 200 were published; among them: 'Star-fishes' (1841); 'The Radiata and Mollusca of the Ægean' (1843); 'Travels in Lycia' (1846); 'Naked-eyed Medusæ' (1847); 'British Mollusca' (1853); 'Literary Papers by E. Forbes' (1855).

Forbes, Edwin, American landscape and genre painter: b. New York 1839; d. Flatbush, L. I., 1895. He was a pupil of A. F. Tait, and became special artist for 'Frank Leslie's Magazine' during the Civil War. The drawings which he made during that time are now in the war office at Washington, and are of historic value.

Forbes, Evelina Louisa Michell, English novelist: b. Tettenhall. She was married to Hon. Walter Forbes in 1888. Her published books include: 'Fingers and Fortune' (1886); 'Her Last Run' (1888); 'Blight' (1897); 'A Gentleman' (1900); 'Dumb' (1901); 'Unofficial' (1902).

Forbes, Harriette Merrifield, American writer: b. Worcester, Mass., 22 Oct. 1856. She was married to W. T. Forbes 5 Feb. 1884. She has published: 'The Hundredth Town' (1889); 'The Diary of Rev. Ebenezer Parkman' (1899).

Forbes, James David, Scottish physicist: b. Colinton, near Edinburgh, 20 April 1809; d. Clifton, England, 31 Dec. 1868. He was admitted to the Scottish bar in 1830; in 1833 was appointed to the chair of natural philosophy in the University of Edinburgh, and in 1860 became principal of the United Colleges of St. Salvador and St. Leonard, in the University of St. Andrews. His fame rests chiefly on his study of glaciers. His chief publications on this subject are: 'Travels through the Alps of Savoy' (1843); 'Norway and its Glaciers' (1853); 'Tour of Mont Blanc and Monte Rosa' (1855); and 'Occasional Papers on the Theory of Glaciers' (1859). Forbes' theory was that glacier ice moves in its channel like a viscous fluid, the middle moving faster than the sides, and the upper portions faster than the lower.

Forbes, John Colin, Canadian artist: b. Toronto, Canada, 23 Jan. 1846. He studied at the Royal Academy, London, England, and on the continent, and returning to Canada he became a successful landscape and portrait painter. Among his works are: 'Foundering of the Hibernia'; 'The Mount of the Holy Cross'; 'The Glacier of the Selkirk'; 'The Lily'; and portraits of Gladstone, Sir John A. Macdonald, the Marquis of Dufferin, Lady Helen Blackwood, and Sir Charles Tupper.

Forbes, John Franklin, American educator: b. Middlesex, N. Y., 13 June 1853. He was graduated at the University of Rochester in 1878; and in 1885 was made president of the John B. Stetson University in Deland, Fla.

Forbes, John Murray, American clergyman: b. 5 May 1807; d. 1885. He was graduated at Columbia College 1827, and at the General Theological Seminary of the Protestant Episcopal Church 1830. He was ordained to the ministry in the year last named, and became rector of St. Luke's Church, New York, 1834. He adopted the Roman Catholic faith in 1849, and was appointed pastor of St. Ann's Church in New York shortly afterward. Returning to his earlier faith in 1859, he was restored to the ministry 1862 and was dean of the General Theological Seminary of the Protestant Episcopal Church 1869-72.

Forbes, John Murray, American merchant: b. Bordeaux, France, 23 Feb. 1813; d. 12 Oct. 1898. He entered a Boston counting room at 15 and in 1834 became a partner in the firm of Russell & Company, china merchants in Boston. He built many clipper ships for the California trade, and was later prominent in railway managements. Naushon, the largest of the Elizabeth Islands, Mass., was owned by him and constituted his summer home where many notables were entertained by him. See Hughes, 'Letters and Recollections of John Murray Forbes' (1899).

Forbes, Stanhope Alexander, English artist: b. Dublin, Ireland, 18 Nov. 1857. He was educated at Dulwich College and studied art at the Royal Academy Schools, and under Bonnat in Paris. Among his pictures exhibited at the Royal Academy are: 'The Fish Sale'; 'The Health of the Bride'; 'By Order of the Court'; 'The Salvation Army'; 'Forging the Anchor.'

Forbes-Robertson, John, English art critic: b. 30 Jan. 1822; d. London 25 Feb. 1903. He was educated at the University of Aberdeen, went to London at 21, and after visiting various art centres devoted himself to literature and criticism. He has published: 'The Great Painters of Christendom'; and lives of Gustave Dore, Rosa Bonheur, etc.

Forbes-Robertson, Johnston, English actor: b. London 16 Jan. 1853. He is the son of John Forbes-Robertson (q.v.) and has been prominent on the English stage since he was 21.

Force, Manning Ferguson, American soldier and author: b. Washington, D. C., 1824; d. 1899. He was the son of Peter Force (q.v.). He was graduated at Harvard College 1845 and at the Harvard Law School, entering the army in the Civil War as major of the Twentieth Ohio Volunteers, and attaining the rank of brevet major-general of volunteers. He was judge of the court of common pleas of Hamilton County, Ohio, 1867–77, and judge of the superior court of Cincinnati 1877–8. He published: 'From Fort Henry to Corinth' (1881); 'Marching Across Carolina' (1883); 'Personal Recollections of the Vicksburg Campaign' (1885); etc.

Force, Peter, American historian: b. near Little Falls, N. J., 26 Nov. 1790; d. Washington, D. C., 23 Jan. 1868. His life work, entitled 'American Archives,' a valuable collection of 22,000 books and 40,000 pamphlets, was bought by the government (1867) and placed in the library of Congress. He published also: 'Grinnell Land: Remarks on the English Maps of Arctic Discoveries in 1850–1' (1852); and 'Notes on Lord Mahon's History of the American Declaration of Independence' (1855).

Force, the immediate agency by which the motion of a body is increased or diminished, or changed in direction, or by which such changes are opposed. A force is measured, in theoretical mechanics, by the increase of velocity that it can produce upon a body of unit mass, when it acts upon that body for one second. Suppose, for example, that a uniform force of magnitude F acts for T seconds upon a body of mass M, thereby increasing (or diminishing) its velocity by V units. Then the magnitude of the force is defined by the equation $F = \frac{MV}{T}$. If M is expressed in grams, and V is expressed in centimetres per second, then F, as calculated by means of this equation, is expressed in dynes. If M is expressed in pounds, and V in feet per second, then F, as calculated from this equation, is expressed in «poundals»; the word «poundal» (for which we are indebted to Prof. James Thomson) denoting the force which will increase (or diminish) the velocity of one pound of matter by one foot per second, when it acts upon it for one second. It is known by experiment that when a body falls freely under the influence of gravity, its velocity, at the end of one second, is about 32.2 feet per second. Let the body in question have a mass of M pounds, and let F be the attraction of the earth upon one pound of matter, as expressed in «poundals.» Then the total force, F, that is acting upon the body is $F = Mf$; and hence the foregoing equation gives us, for this case (remembering that $T = 1$), $Mf = 32.2M$, or $f = 32.2$; and hence it follows that the attraction of the earth upon one pound of matter is 32.2 poundals in a region where gravity, when acting freely upon a body for one second, increases its velocity by 32.2 feet per second. If we follow the usual custom and represent the accelerative effect of gravity at any place by the letter g (instead of by the particular value 32.2), we may make the following general statement, which may also be taken as the definition of the poundal: In a region in which gravity increases the velocity of a falling body by g feet per second, per second, the earth attracts one pound of matter with a force of g poundals.

A force is said to be «central,» when it acts always toward a definite centre, which may be either fixed or in motion. The gravitative forces with which the heavenly bodies act upon one another are of this character, and are often popularly called «centripetal» (that is, «centre-seeking») forces for this reason. When a body is caused to move in a curved path, it exerts a force which acts along the radius of curvature of the path, and in a direction away from the centre of curvature. Forces of this nature are called «centrifugal» (or «centre-fleeing»), and familiar examples are afforded by the pressure of swiftly moving water against the curved vanes of a turbine water-wheel. and by the tension produced in a string when a stone that is attached to the string is whirled rapidly about in a circle. The nature of centrifugal force has been the subject of more or less controversy, some authorities maintaining that it should not be classed as a true force, since it does not produce any acceleration in the direction in which it acts; — that is, a particle on the rim of a swiftly revolving wheel does not fly off radially when it is liberated, but merely continues its motion with unaltered speed, in the direction in which it was moving at the instant of its liberation; — or tangentially to the wheel. The subject is too technical for discussion in this place, but it may be pointed out that such a particle is actually subject to a radial acceleration, if its motion is considered *relatively to the wheel.*

Forces are said to be «conservative» when the principle of the conservation of energy holds true for the systems in which they occur (see ENERGY). All of the forces of nature are believed to be fundamentally conservative, although this has not yet been rigorously proved for the forces that prevail within animals and plants.

A «field of force» is any region in which a given force has a sensible magnitude. A conductor charged with electricity, for example, exerts an attractive (or repulsive) force upon all bodies that are exterior to it, and, from the point of view of theoretical physics, this force still exists at an infinite distance from the charged body, though at such a distance it becomes infinitesimal in intensity. From a practical standpoint, however, the «field of force» due to the charged body can be considered to be limited by an indefinite but finite boundary, whose distance from the body depends upon the intensity of the charge, and also upon the order of minuteness of the forces that can be regarded as negligible, so far as any effect upon the problem that happens to be under consideration is concerned. Within a closed conductor there is no field of electric force, so long as the charges upon the conductor itself, and in the region external to it, are in equilibrium. This fact may be demonstrated mathematically, and it was also abundantly proved, experimentally, by Faraday. (See ELASTICITY; ELECTRICITY; ETHER; GRAVITATION; MECHANICS; etc.) Consult, also, Mach, 'Principles of Mechanics'; Pearson, 'The Grammar of Science'; Ziwet, 'Elementary Treatise on Theoretical Mechanics.'

Force Bill, a popular name in the United States for four different congressional bills, used at the time of their passage; all aimed at the South, and intended to suppress by national force direct or indirect nullification (q.v.) of national laws. (1) The bill of 2 March 1833 to enforce the tariff law; drawn out by Calhoun's nullification ordinance passed by the South Carolina legislature (See COMPROMISE OF 1833); also called the "Bloody Bill." It was not put in action, because South Carolina first suspended and then repealed the Nullification Ordinance. (2) The bill of 31 May 1870 to put down the forcible resistance which the Southern leaders were preparing to offer to the reconstruction governments. It punished by fine and imprisonment, or both, and gave the Federal courts exclusive cognizance of any interference with the registration, voting, etc., of any one, or going on his premises to intimidate him, or personating him in voting or violating State or Federal election laws, or violating the Civil Rights Bill of 1866. (3) The bill of 20 April 1871 to suppress the Kuklux Klan (q.v.). It gave the Federal courts cognizance of suits against any one depriving another of any constitutional rights; punished as conspiracy any combination to delay the execution of any Federal laws, or deter any one from voting, holding office, or acting as Federal juror or witness; (this clause was held unconstitutional by the Supreme Court); authorized the President to employ the national forces to suppress disorders intended to deprive any class of their constitutional rights, in case the State authorities were unable or unwilling; suspended the habeas corpus "during the continuance of such rebellion" — this provision to remain in force only till the end of the next regular session; authorized the judges to exclude from the juries persons they suspected to be in complicity with the proscribed acts; authorized civil action for damages against all persons who neglected to give warning of such a conspiracy or intended injuries, if they had good reason to suspect them; and confirmed former civil-rights legislation. An attempt was made to extend the fourth suspension of the habeas corpus to May 1872, and the Senate did so, but the House refused. (See RECONSTRUCTION.) (4) The Lodge Election Bill, 2 July 1890, "to amend and supplement the election laws of the United States, and to provide for a more efficient enforcement of such laws." It passed the House, but was tabled in the Senate by a free-coinage fusion of Democrats and Republicans who wished to pass to currency legislation.

Force of Gravity. The determination of the force of gravity from point to point over the earth's surface is a matter of importance. The force of gravity is not the same all over the surface of the earth. It is least at the equator, and it gradually increases as we recede toward the poles. Thus a given mass, if tested by means of a spring-balance of sufficient delicacy, would appear to weigh least at the equator, and would seem to get heavier and heavier as the latitude increases. This is due to two causes: (1) owing to the rotation of the earth on its axis every particle of matter tends to fly off from the surface by centrifugal force. The apparent force of gravity at any place is therefore the force of gravity at that place diminished by the centrifugal force. The centrifugal force at the equator is greater than that in high latitudes, because of the greater radius of the circle described at that place. The second cause is the oblate form of the earth. The earth is not a true sphere, but is flattened at the poles. Hence the distance of any attracted point at the equator from the centre of the mass is greater than that of points situated at or near to the poles; the attraction is, therefore, less at the equator than in high latitudes. Experiments to determine the force of gravity from point to point are made by determining the length of a pendulum, that beats seconds at each place. This being known, the force of gravity is easily calculated. See PENDULUM.

The following table gives the lengths of the seconds pendulum at different places, as determined by various experimenters, and also the force of gravity as deduced from their observations:

THE VALUE OF THE ACCELERATING FORCE OF GRAVITY AT DIFFERENT PLACES.

OBSERVER	PLACE	Latitude	Length of seconds pendulum in inches.	Acceleration of gravity in feet per second.
Sabine	Spitzbergen	N. 79° 50′	39.21469	32.2528
Sabine	Hammerfest	N. 70° 40′	39.19475	32.2363
Svanberg	Stockholm	N. 59° 21′	39.16541	32.2122
Bessel	Königsberg	N. 54° 42′	39.15072	32.2002
Sabine Borda	Greenwich	N. 51° 29′	39.13983	32.1912
Biot and Sabine	Paris	N. 48° 50′	39.12851	32.1819
Biot	Bordeaux	N. 44° 50′	39.11296	32.1691
Sabine	New York	N. 40° 43′	39.10120	32.1594
Freycinet	Sandwich Islands	N. 20° 52′	39.04690	32.1148
Sabine	Trinidad	N. 10° 39′	39.01888	32.0913
Freycinet	Rawak Island (Pacific)	S. 0° 2′	39.01433	32.0880
Sabine and Duperrey	Ascension	S. 7° 55′	39.02363	32.0956
Freycinet and Duperrey	Isle of France	S. 20° 10′	39.04684	32.1151
Brisbane and Rümker	Paramatta	S. 33° 49′	39.07452	32.1375
Freycinet and Duperrey	Falkland Islands	S. 51° 35′	39.13781	32.1895

Forcible Entry and Detainer. A phrase belonging to law which relates to the keeping of real property, by threats or violence, from its rightful owner. In such cases as clearly show intentional exclusion of the real owner from his property, the latter can have recourse to law; but even he may not force an entrance into his premises — so sacred is the presumptive right of possession in the eyes of the law. Public peace, too, would seem to be the other valid consideration involved in seeking to compel disputants to settle their disputes in a court of justice.

This law dates from the time of Richard II of England, before which time an owner had full right to take possession of his property *by force*, if necessary. Since that time, however, a number of statutes have limited the owner's right to his property as indicated above. The owner, however, does not forego any property rights by merely abstaining from forcible entry thereto; nor does this passivity on his part establish the least bit of presumption in favor of the illegal possessor. The law, which has been enacted in every state in this country, merely limits his mode of re-taking possession to a legal process. Further than this, the owner's rights to his property are not invalidated in the slightest degree. Besides the United States and England, most other civilized countries have similarly modified the common law by statutes affecting forcible entry.

Forcing, in gardening, is a term used to designate a process in which artificial heat is applied so that flowers, fruits, or other products of plants are obtained at a date or season other than that at which they may be had in the ordinary course of culture. Thus, for example, kinds of grapes which by the simple influence of the heat of the sun in a vinery do not ripen till September or October are induced by forcing to ripen in March or later, according to the period the process is commenced; and strawberries, which ripen from June to September, in the forcing-house yield their fruit from February onward. Conducted, as the system is, during the short days of the year, the chief obstacle the gardener has to contend with is diminished light. This in the case of forcing fruits taxes his skill to the utmost, because abundant light is essential both to the proper fertilizing of the flowers and to the perfecting of the fruit. Some vegetables and salads and many flowers are, however, more successfully forced in the dark than in light. Rhubarb, seakale, mushrooms, lily of the valley, lilac, are all forced in greater or less darkness. Among flowers, roses, carnations, lilies of the valley, azaleas, deutzias, violets, mignonette, and sweet peas are those most commonly forced, along with such bulbs as hyacinths, tulips and narcissi. By the application of an atmosphere containing ether, the forcing of certain flowers, particularly lilacs, has been much accelerated, and a quick and regular development secured, but the process is yet in an experimental stage. See 'The Forcing Book', by L. H. Bailey (1897); 'Greenhouse Construction and Greenhouse Management', by L. R. Taft (1903); W. J. May's 'Greenhouse Management' (3d ed. 1900).

Ford, Edward Onslow, English sculptor: b. London 1852; d. 1901. He studied in Antwerp and Munich, and was made a Royal Academician of London in 1859. His artistic faculty was displayed in felicitous portraiture, and he executed striking statues of many eminent contemporaries, including Gladstone and «Chinese» Gordon. The Marlowe Memorial at Canterbury and the Shelley Memorial at University College, Oxford, are also from his chisel. A monument to his memory was unveiled in Grove End Road, Saint John's Wood, London, 13 July 1903.

Ford, Henry Jones, American editor: b. Baltimore, Md., 25 Aug. 1851. He was graduated from the Baltimore City College in 1868, was connected with the *American* and *Sun* of Baltimore and the *Sun* of New York, and in 1901 became editorial manager of the Pittsburg *Commercial Gazette* and *Chronicle-Telegraph*. He published 'The Rise and Growth of American Politics' (1898).

Ford, James Lauren, American journalist: b. St. Louis, Mo., 25 July 1854. He has written several volumes of short stories and essays, among which are: 'Hypnotic Tales' (1891); 'The Literary Shop' (1894); 'Bohemia Invaded'; 'Dolly Dillenback.' He is also the author of two books for young readers: 'Dr. Dodd's School' (1892); and 'The Third Alarm' (1893).

Ford, John, English dramatist: b. Devonshire 1586; d. after 1639. He printed his first tragedy of the 'Lover's Melancholy' in 1629. This, however, was not his first play, as a comedy of his, entitled 'A Bad Beginning has a Good End,' was acted in 1613. His genius is seen at its highest in the tragedy, ''Tis Pity Shee's a Whore' (1633), though the subject is repulsive. He wrote, or assisted to write, at least 11 dramas. Most of these were exclusively his own composition; but some of them were written in conjunction with Decker and others. Other plays by him are: 'The Broken Heart' (1633); 'Love's Sacrifice' (1633); 'Perkin Warbeck' (1634); 'The Fancies Chaste and Noble' (1638); and 'The Ladies' Trial' (1638).

Ford, Paul Leicester, American author: b. Brooklyn, N. Y., 23 March 1865; d. New York 8 May 1902. Besides numerous pamphlets relating to American historiography his works include: 'The Honorable Peter Stirling' (1894), a novel of New York society; 'The True George Washington' (1896); 'Bibliotheca Hamiltonia'; 'Franklin Bibliography'; and an edition of the works of Thomas Jefferson (1897), with notes, biographical introduction, etc.; 'The Story of an Untold Love'; 'Tattle Tales of Cupid'; 'Short Stories'; 'Janice Meredith' (1899); 'Wanted — a Matchmaker'; etc.

Ford, Richard, English critic and author: b. London 1796; d. 1858. Having travelled in Spain, visiting the various art centers, he contributed articles dealing with Spanish art and architecture to the *Quarterly Review*, and published 'Handbook for Travellers in Spain' (1845), describing the countries and cities, the natives and their manners, antiquities, religion, legends, fine arts, etc., with notices on Spanish history. Revised edition 1855.

Ford, Sallie Rochester, American story-writer: b. Rochester Springs, Boyle County, Ky., 1828; d. 1902. She married S. H. Ford in 1855, and with him edited the ‘Christian Repository’ and the ‘Home Circle’ for many years. Among her published works are: ‘Grace Truman’ (1857); ‘Mary Bunyan’ (1859); ‘Morgan and His Men’ (1864), and ‘Ernest Quest’ (1887); ‘The Inebriates’; etc.

Ford, Washington Chauncey, American statistician: b. Brooklyn, N. Y., 16 Feb. 1858. He is a brother of P. L. Ford (q.v.). He was chief of the bureau of statistics, Department of State, 1885–9, and of the bureau of statistics in the Treasury Department in 1893–8; was connected with the Boston Public Library 1897–1902, and was chosen lecturer on statistics in the University of Chicago in 1901. He published: ‘American Citizen's Manual’; ‘The Standard Silver Dollar’ (1884); ‘George Washington’ (1899).

Fordham, fôr'dam, a part of New York in the borough of Bronx. Prior to 1874 it was a village in Westchester County, N. Y. Fordham was made a manor in 1671. St. John's College is located here. The poet E. A. Poe lived in Fordham for a number of years and wrote ‘The Bells’ and other pieces here.

Ford's Theatre, a Washington theatre in which President Lincoln was shot by the assassin, Booth, 14 April 1865. The United States government purchased the building in 1866, and it was at first used as the Army Medical Museum, but after 1887, as the Pension and Records Bureau of the War Department. It gradually fell into ruin, however, and suddenly collapsed with the loss of several lives, 9 June 1893.

Fordun, John of, known as the father of Scottish history: b. probably at Fordoun, Kincardineshire, about 1310; d. about 1386. He wrote the first five books of his ‘Chronica Gentis Scotorum,’ bringing the history down to the middle of the 12th century, and also a part of the sixth volume, which was completed by Walter Bower, abbot of the monastery of Inchcohn. He enlarged the first five books and added 11 new ones, bringing the history down to 1437. Several editions have been printed, the best probably being that of W. F. Skene (Edinburgh 1871–2).

Forearm. See ARM.

Forecasting the Weather. See METEOROLOGY.

Foreclosure is the right of a mortgagee, or of any one having interest in a mortgage, in the event of the conditions of the mortgage being violated, to compel the mortgagor to redeem the pledge or forfeit his right of redemption. This is done by filing a bill for foreclosure. The court may, on application of the mortgagee, mortgagor, or any incumbrancer of the mortgage, grant, under certain conditions, a sale of the subject instead of foreclosing the mortgage, the money raised by the sale being applied to the payment of the mortgage, any surplus being claimed by subsequent mortgages, or in the event of no other claim, being paid to the mortgagor.

Forefathers' Day, the day celebrated as the anniversary of the landing of the Pilgrims; first commemorated in 1769. Owing to a mistake in the change of Old Style (11 December) to New it was made 22 instead of 21 December.

Foreign Coins and Their American Equivalent. As the monetary value of national coins is subject to frequent change, it is impossible to prepare a statement which would correctly specify the value of any particular coin at any future time. As such changes are correspondingly slight, however, the following list of the coins of all nations will always be comparatively correct, the values in the moneys of account of the United States having been corrected to 1 April 1905 by the director of the mint, United States Treasury Department:

Argentine Republic.— Gold coins: argentine ($4.824) and half argentine; silver coins: peso ($0.965) and its divisions.

Austria-Hungary.—By a law passed 2 April 1892 the monetary system of Austria-Hungary was reformed on a gold basis, with the crown ($0.203) as a unit. The coins issued under the old system are still in circulation, however. They are, gold: eight florins ($3.858), 4 florins, ducat ($2.287), and 4 ducats; silver: florin ($0.5052) and 2 florins. The coins under the new system are, gold: twenty crowns ($4.052), 10 crowns, and 1 ducat ($2.287); silver: one crown ($0.203); nickel: twenty hellers ($0.0405) and 10 hellers; bronze: two hellers, or one kreutzer ($0.0040), and one heller.

Belgium.— Belgium being a member of the Latin Union, its monetary unit is the franc ($0.193), and its coins the gold 10 and 20 franc pieces and the silver 5 francs.

Bolivia.— The boliviano ($0.439) is the monetary unit of Bolivia. Its coins, all silver, are the boliviano, the 50, 20, 10, and 5 centavo ($0.0211) pieces.

Brasil.— The milreis ($0.546) is the monetary unit of Brazil. Its gold coins are 5, 10, and 20 milreis pieces; its silver coins, ½, 1, and 2 milreis.

Bulgaria.— The monetary unit is the lev ($0.185) which is supposed to correspond to the franc of other double standard countries. In fact, but few Bulgarian gold coins are in circulation, the necessary gold coins being supplied by foreign 10 and 20 franc pieces. The silver coins are the ½, 1, 2, and 5 leva pieces; the nickel coins are the 2½, 5, 10, and 20 stotinki ($0.0385), and there are copper coins of 1, 2, 5, and 10 stotinki.

Canada.— The gold dollar ($1) is the monetary unit. The silver coins are the 50, 25, 10, and 5 cent pieces. Some penny (2 cents) and half penny pieces are in circulation.

Chile.— The value of the peso, the monetary unit, is ($0.365). The gold coins of the country are the escudo ($1.825), doubloon ($3.65), and the condor ($7.30). The peso and its divisions are coined in silver.

China.— The monetary system of China is in an extremely chaotic condition. The unit and sole official coinage is the copper cash, 11 of which are equal to one cent. The silver tael, or liang, varies in value in different parts of the country, as follows:

THE CHINESE TAEL.

PLACE	Value	PLACE	Value
Amoy	$0.719	Nankin	$0.712
Canton	0.717	Ninchwang	0.674
Chefoo	0.688	Ningpo	0.691
Chin Kiang	0.703	Pekin	0.701
Fuchau	0.665	Shanghai	0.657
The Haikwan or customs tael	0.732	Swatow	0.664
		Takeu	0.724
Hankow	0.673	Tientsin	0.697

In Hong Kong and Labuan, the "British Dollar" has the same legal value as the Mexican dollar.

Colombia.— The gold dollar ($1.) is the monetary unit. Other gold coins are the condor ($9.647) and the double condor. The silver peso ($0.9352) and its divisions are coined.

Costa Rica.— The gold colon ($0.465) is the unit of the country. Two, 5, 10, and 20 colon pieces are coined in gold; 5, 10, 25, and 50 centimor ($0.2326) pieces in silver.

Cuba.— As Cuba is a gold standard country, its monetary unit, the peso, is a gold coin valued at $0.91. The gold doubloon, valued at $5.017, and the Alphonse, valued at $4.823, are also used, as well as several foreign coins. The silver coinage of Cuba is the peso ($0.455) and its divisions.

Denmark.— The monetary unit is the crown ($0.268) and gold 10 and 20 crown pieces are coined. The minor coinage, in silver and bronze, is represented by the 50 ore ($0.1247) and its divisions.

Ecuador.— The gold sucre ($0.487) is the unit, but the 10 sucrae piece is the only gold coin. The minor coinage, the 10 and 5 real ($0.0467) pieces, is of silver.

Egypt.— The gold pound, representing 100 piasters ($4.943) is the unit, and 50, 20, 10, and 5 piaster pieces are also coined in gold. The silver coinage is represented by the 1, 2, 5, 10, and 20 piaster pieces.

Finland.— The markkaa ($0.193) is the monetary unit, and the gold coins are 20 and 10 markkaa pieces. The 50 penni ($0.0794) and the 10 and 1 penni ($0.0019) pieces, in bronze, constitute the smaller coinage.

France.— The gold franc, valued at $0.193, is the unit of the country. Gold 5, 10, 20, 50, and 100 franc pieces, and silver 5 and single franc pieces are coined. The minor coinage is represented by the 50, 20, 10, and 1 centime ($0.0019) pieces.

German Empire.— The gold mark ($0.238) is the unit, and 5, 10, and 20 mark pieces are coined in gold. The 50 pfennigs ($0.1039) and the thaler ($0.6928) represent the silver, the 5 pfennigs, the nickel, and the single pfennig the bronze coinage.

Great Britain.— While the monetary unit for the colonies varies, that for Great Britain itself is the gold pound sterling ($4.8665). The pound sterling (the sovereign), and the half sovereign are coined in gold; the crown ($1.0872), half crown, florin ($0.4348), shilling ($0.2174), sixpence ($0.1017), four pence ($0.0724), three pence ($0.0543), and the two pence ($0.0362) in silver, with the penny ($0.02), half penny, and farthing ($0.005) in bronze.

Greece.— The drachma ($0.193) is the monetary unit. Five, 10, 20, 50, and 100 drachma pieces are coined in gold, 5 drachma pieces in silver, 20 and 5 lepta ($0.0096) in nickel, and 1 and 2 lepta pieces in bronze.

Guatemala.—The silver peso ($0.439) is the monetary unit and this coin and its divisions are coined in silver.

Haiti.— The gourde ($0.965) is the unit of the country; 1, 2, 5, and 10 gourde pieces are coined in gold, and the single gourde and its divisions in silver. The smaller coin is the bronze centime ($0.0096).

Hawaii.— Same as United States.

Honduras.— The peso ($0.439) is the monetary unit and this coin and its divisions are coined in silver.

India.— The pound sterling, or sovereign, is the standard coin of India, but the rupee ($0.324433) and its divisions is the money of account.

Italy.— The lire ($0.193) is the monetary unit. The 5, 10, 20, 50, and 100 lire pieces are coined in gold; 5 lire pieces in silver, while the 20, 10, and 1 centesimo ($0.0019) in nickel and bronze represent the minor coinage.

Japan.— The yen ($0.498) is the unit of the country. Gold 5, 10, and 20 yen pieces are coined; 10, 20, and 50 sen ($0.448) silver pieces, with 5 sen, 1 sen, and 5 rin ($0.0024) pieces in bronze.

Liberia.— The only official coin of Liberia is the gold dollar ($1.).

Mexico.— The silver dollar, valued at $0.458, has long been the monetary unit of Mexico, but a change to the gold standard, which is about to be established, will give the country a gold dollar of the value of about fifty cents. The several divisions and multiples of the dollar will also be coined.

Netherlands, The.— The gold florin ($0.402) is the monetary unit. Gold 10 florin pieces are coined as well as ½, 1, and 2½ florin pieces in silver. The cent ($0.004) is of bronze.

Newfoundland.— The gold dollar of Newfoundland is valued at $1.014.

Nicaragua.— The silver peso ($0.439) is the unit, and this coin and its divisions are coined in silver.

Norway.— Same as Sweden.

Panama.— The balboa, valued at $1. in gold, is the monetary unit. At present no gold is coined, the only coin being the silver dollar ($0.50) and its divisions.

Paraguay.— The country has no coinage, but the silver pesos of other South American republics circulate there at the same value as in the countries where they are issued.

Persia.— The silver kran ($0.078) is the monetary unit. Gold ½, 1, and 2 tomans ($3.408) pieces, and silver ¼, ½, 1, 2, and 5 krans are coined. The copper coins are the chai ($0.0085) and the abassi, valued at 4 chais.

Peru.— The sol ($0.487) is the monetary unit. Gold libra ($4.8665) are coined, as well as the silver sol and its divisions.

Philippine Islands.— By act of the 57th Congress the authorized coins of the Philippines are silver pesos of 10, 20, and 50 centavos (cents) value, and of copper ranging from ½ cent to 5 centavos in value.

Portugal.— The milreis ($1.08) is the monetary unit and 1, 2, 5, and 10 milreis pieces are coined in gold. The silver coins of this country are 1,000 reis ($0.9526) and 50 reis; the nickel coins, 100 reis and 50 reis, and the bronze coins, 20 and 5 reis.

Rumania.— The gold lei ($0.193), corresponding to the franc, is the monetary unit. Twenty and 10 leis pieces are coined in gold, 5 and single lei pieces in silver, and 10 and 1 bani ($0.0019) pieces in bronze.

Russia.— The ruble ($0.515) is the monetary unit. Gold imperials, valued at 15 rubles, and half imperials are coined. The ruble, as well as the 50 and 5 copeck ($0.0187) pieces, are of silver, while the single copeck and a 5 copeck piece are coined in copper.

Salvador.— The silver peso ($0.439) is the unit, and this coin and its divisions are coined in silver.

Servia.— The dinar ($0.173) is the monetary unit. The 20 and 10 dinar pieces are of gold; the 5 and 1 dinar pieces of silver, while the 20, 10 and one para ($0.0019) pieces, in nickel and bronze, represent the minor coinage.

Siam.— The monetary unit is the silver fical ($0.28). The other coins current are the salung (¼ fical) and the juang (⅛ fical).

Spain.— The peseta ($0.193) is the monetary unit. The several divisions and multiples of the peseta are coined in gold and silver, while the minor coinage, ranging from one centimo ($0.0019) to 50 centimos, are of silver or bronze.

Sweden and Norway.— The gold crown ($0.268) is the unit, and 10 and 20 crown pieces are coined in gold. The silver coinage includes the 2 crown piece, the single crown, and the 50 and 10 ore ($0.0241), while the single and the 5 ore pieces are of bronze.

Switzerland.— The gold franc, valued at $0.193, is the monetary unit. Gold 5, 10, 20, 50, and 100 franc pieces, and silver 5 and one franc pieces are coined. The minor coinage includes the 50, 20, 10, and single centimes ($0.0019).

Turkey.— The piaster ($0.044) is the monetary unit and the gold coins include the 25, 50, 100 (the lira), 250, and 500 piaster pieces. The ½ piaster, the single piaster, and the 20 piaster pieces are of silver, while a piaster and the para ($0.0001) are of copper.

Uruguay.— The peso ($1.034) is the only gold coin authorized in Uruguay, but the silver peso ($0.403) and its divisions are also coined.

Venesuela.— The bolivar ($0.193) is the monetary unit. Gold 5, 10, 20, 50, and 100 bolivar pieces are coined, while the silver coinage includes a 5 bolivar piece as well as the single bolivar and its divisions.

Foreign Exchange. Foreign Exchange is a name applied to that part of banking which deals with transactions between different countries. Since the earliest days of which we have authentic record of human achievements, different communities have traded commodities with each other. Originally the transactions were confined to barter, and the caravan or ship that carried goods to a foreign country traded them directly for goods of supposed equivalent value, which they took back with them to their own countries. The difficulty experienced in making even exchanges of mutually desirable articles led to the formation of banks (see BANKS AND BANKING) and finally to the development of the Foreign Exchange business in its present form.

Due to the fact that it was the first in the field in a scientific way, and also because of its world-wide political interests, Great Britain can truthfully claim that the bulk of the world's business is carried on in its currency — pounds sterling. See MONETARY SYSTEMS OF THE WORLD.

Foreign Exchange being the same in theory the world over and similar in practice, except where influenced by local conditions, we will consider it from the standpoint of the United States. The foreign exchange banker, whether running a separate institution or a department of a bank organized for the handling of both domestic and foreign business, finances the following propositions, which we will divide into two divisions, viz., Exports and Imports, as because of the effect upon exchange everything can be logically classed under these heads:

Exports.— (a) Merchandise; (b) Expenses of travelers to this country; (c) Securities (government, corporation, firms, or individuals, sold abroad); (d) Remittances to this country; (e) Precious metals.

Imports.— (a) Merchandise; (b) Expenses of travelers from this country; (c) Securities (government, corporation, firms, or individuals purchased abroad); (d) Remittances from this country; (e) Precious metals.

First, consider the exports. Different commodities because of their being perishable or otherwise, or because of the different methods of handling that hurry or retard their delivery, have to be financed according to their nature. Thus, for example, we find that meat, cotton, flour, and machinery are, as a rule, all financed on a different basis. Because of the time necessary to collect drafts against exports, only concerns of large free capital over and above the needs of their domestic business could sell their goods to foreign buyers, if it were not for the foreign exchange banks or departments that pay cash for the goods on delivery of documents. The transactions are consummated as follows: Bids are asked for on bills drawn against merchandise by telephone, telegraph, and over the bank's counter, and are accepted or rejected as they are in or out of line with bids of competitors, with the exception of bills that are placed for deposit regularly with some one concern, in which case rates are applied according to the market. In purchasing bills the following questions arise in the mind of the buyer: Is the responsibility of the seller of the exchange sufficient to warrant the purchase of the bill? If it is a long time bill is it drawn upon responsible banks or buyers? Is the market value of the goods covered by the shipment stable, and if not, is the value at the time of the offer low enough to warrant the purchase? These questions answered satisfactorily, next comes the point of rate to be paid, which is based upon the following conditions (in this country bills are ordinarily drawn in the currency of the country of the drawee). The laws and customs of the country upon which the bill is drawn concerning the class of exchange offered, for instance as to delivery of documents, stamp tax, days of grace, etc., the value of demand exchange in New York on day of purchase, the rate of New York exchange at interior points (when such points are the seat of purchase), the current rate of interest obtainable upon loans, the call money rate in New York, the bank and private discount rates in the country on which the bill is drawn, the market tendency in foreign exchange and the rates for other foreign exchanges, both in this country and in the country on which the draft is drawn.

The rate being made and accepted, the exporter obtains the necessary papers and delivers them to the foreign exchange banker, where he is either given a cashier's check or credit in account for the amount of the bill at the agreed rate, provided the documents are in order. Every piece of paper handled is carefully checked up as follows: To see that the conversion rate when applied to the bill equals the dollars paid the depositor; that bills of lading are drawn to the order of shipper and indorsed in blank; that all negotiable copies of the bill of lading are attached to the draft, which is in nearly all cases drawn in duplicate; that the goods covered by the bill of lading cover the draft at market rates; that the goods are insured while in transit and a certificate in proper order accompanies the draft; that invoices, and where necessary consular certificates, are attached, and that where a general hypothecation is not held, a special hypothecation covering the particular shipment accompanies the other papers. Documents, of course, vary somewhat from the above, but this covers the bulk of the business.

Travelers to this country ordinarily carry travelers' letters of credit, in order to provide for their expenses. Drafts drawn against such letters are cashed by the foreign exchange banker, which further increases his funds abroad. See Credit, Letter of.

The next division under exports is the handling of stocks, bonds, or other securities purchased from us by foreigners. In such cases drafts are drawn and the securities are attached or notice is sent to the effect that they are going forward under another cover, and where necessary, insurance is carried.

Remittances from foreign countries are also in effect exports, as the amount drawn by foreign bankers is either credited to the account of the payee bank or draft is drawn against balances in this country that were built up in a similar manner.

In all these divisions under exports the foreign exchange banker is in effect paying out funds in his city for which he receives or will receive foreign money at the point of destination for bills, securities, and drafts drawn against letters of credit, and in the case of remittances, at the points from which they originate.

Secondly, we will consider the imports. The importer causes the demand for the exchange that the exporter has made and is accommodated in two ways, either through the direct sale to him of demand or cable exchange and sometimes long bills, or through the issuance of commercial letters of credit. Merchandise, the first division under imports, is usually brought in under commercial letters of credit. In issuing such credits the banker is again confronted with the proposition of financial responsibility, this time of the importer, together with the marketable nature of the goods which he wishes to import, their prices, etc. If everything is satisfactory and the credit is granted, the foreign shipper is authorized by the bank to draw upon some convenient foreign correspondent for the value of the goods, the foreign banker being authorized to honor such draft upon delivery to him by the foreign seller of documents evidencing the shipment, etc., which correspond identically with those required in advancing money to an exporter whose credit is not sufficient without such assurance or where the standing of the purchaser of the goods is not high enough so that the exporter himself is willing to make the shipment without such a letter. The documents delivered to the foreign banker come forward to this country and are delivered to the customer against trust receipt before the draft for the goods matures, or are held for payment of the draft as special cases may require. Where letters of credit are drawn for 30, 60, 90 days, or other maturities, the actual money is not advanced as in the case of the exporter, but credit is extended through the acceptance by the foreign banker of the time bill against guarantee.

The American traveler in foreign countries is really an importer, for he buys in foreign lands amusement, experience, and other trifles to bring back to the United States either in memory or in bulk. See CREDIT, LETTER OF.

Securities imported are handled in the same manner as those exported, with the exception of the fact that more often payment is made out of balances of American banks in the foreign centres than by the foreign banker against his draft.

Remittances to foreign countries consist largely of money being returned by foreigners who are located here. This is ordinarily done by so-called postal remittances or drafts, and is in effect an import, as foreign balances are reduced in order to pay them, the same as if goods had been purchased abroad.

An item that enters largely into the foreign exchange business is the shipment of precious metals. In dealing with the Orient the price of silver enters largely into the price of exchange, as the old Mexican dollar is the accepted standard in Hong Kong, which is the business centre of the far East.

As gold is used more largely the world over for the purpose of settling so-called trade balances, we will consider the part it takes in foreign commerce more in detail. The various countries of the world have moneys of different denominations and values (see FOREIGN COINS AND THEIR AMERICAN EQUIVALENTS), and in order to get a common basis from which to figure values, the relations between the moneys are based upon the actual pure gold value in the principal coin of each country. For instance, in the case of Great Britain and the United States the pure gold in a pound sterling is found to be equivalent to the gold in 4.86656 American dollars, and this rate is called the mint par of exchange. When the exchange rate is enough higher than the par of exchange to make it profitable to ship gold abroad and sell exchange against balances so made, the export point is said to have been reached, and where the rate falls so low that exchange can be purchased and gold shipped in to replace the funds used for the purchase of the exchange, it is called the import point.

The theoretical export and import points are constant, but the actual points at which gold can be profitably shipped vary considerably, the difference between the actual and theoretical export and import points being made up of the following items: Boxing and cartage of the gold, freight to destination, insurance and loss of interest while the gold is in transit. (These costs vary somewhat, depending upon the arrangements different shippers are able to make.) The actual points are also dependent upon other exchanges; for instance, if sterling on London in Paris is abnormally low, gold can be shipped to Paris, and London exchange purchased with the balances so made at a profit, when the rate for drafts on London in this country would not of itself permit of such profit. The price of gold also has a bearing upon the rate, but where gold is exported from this country the cost of the gold is fixed, as the United States Government furnishes gold bars at the rate of four cents per $100, and gold coin can be obtained without premium by demanding same of the United States Government in exchange for gold notes. As this country exports a tremendous amount of cotton, wheat, corn, and other cereals after harvest in the fall, other things being equal, exchange would naturally be lower at this time of year. On the other hand, it would naturally be high during the early summer months, because of the fact that the imports are heavier in proportion at that time. (See EXPORTS AND IMPORTS). This natural condition has been offset largely through the interchange of securities, and also by so-called finance bills. The latter in effect carry over a debt of this country to foreign countries when issued at the time of high exchange to such time as the exports make enough exchange to carry the market down and allow cover at low rates. This often allows the borrowing of money at a very low interest rate, and is much resorted to when discounts abroad are lower than interest rates in the United States, or when exchange is at abnormally high rates without correspondingly divergent interest rates against the transactions. As the bulk of our foreign trade is carried in foreign bottoms, we are obliged to pay immense amounts for freight. Most of our marine insurance is also carried on the other side of the water. Both of these items must be added to the imports before the real balance of trade can be found, but as they can only be estimated and as finance bills are drawn and securities sold back and forth in unknown amounts, there is no time at which the real balance of trade is a known quantity. The demand and supply of exchange that causes fluctuations to reach the gold points is the only real guide to such balance, and even then finance bills in themselves may be sufficient to call forth shipments when the real balance if it were known might be the other way.

The foreign exchange banker in financing the foreign trade of the United States in addition to accepting the ordinary risks entailed in advancing credit to his customers is always at the mercy of the fluctuations in foreign exchange rates, and if it were not for the fact that the two gold points are separated from each other by under ordinary conditions not to exceed one per cent. and usually at a much less difference, it would be impossible for him to work upon the close margins that are now in vogue and that give the exporter and importer the best possible service at an infinitesimal cost. See COMMERCE AND COMMERCIAL TERMS.

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Foreign Judgment, in law, is the term applied to the judgment of a foreign tribunal. Such judgment is proved in common law by exemplifications certified under the great seal of the state or country where the judgment is recorded, or under the seal of the court where the judgment remains; the fulfillment of its conditions depends upon treaty stipulations or on international comity.

Foreign Laws, the laws of a foreign country. The courts do not judicially take notice of foreign laws; and they must, therefore, be proved as facts. Exemplified or sworn copies of written laws and other public documents must, as a general thing, be produced when they can be produced. The effect of foreign laws, when proved, is probably referable to the court; the object of the proof is to enable the court to instruct the jury what is, in point of law, the result from foreign laws to be applied to the matters in controversy before them. The court is, therefore, to decide which is the proper evidence of the laws of a foreign country, and when evidence is given of those laws, the court is to judge of their applicability to the matter in issue.

Foreign States. In law, every nation is foreign to all other nations; and the several States of the American union are foreign to each other, with respect to their municipal laws. The reciprocal relations between the national government and the several States, however, are considered not as foreign, but as domestic.

Foreign Trade. While political economists have engaged in fierce disputations over many economic theories regarding money, wages, distribution and similar subjects, they have allowed the theory of international trade, as it was set forth by John Stuart Mill, to remain unchallenged and unchanged. The principle involved is one of advantage. In general, a given nation will export those articles in the production of which it has an advantage over other nations and import such articles as can be produced cheaper by other nations. This advantage may be absolute, depending upon location, soil, climate, etc., or it be merely relative and artificial, depending, for instance, on a system of protective tariff.

Modern international trade, in all its vastness and complexity, is a comparatively recent development. It may be said to have first begun with the multiplication of steamships and the extension of railroads throughout the world. Among important recent changes affecting foreign trade, and destined to affect it even more in the future, may be mentioned: (1) The acquisition by the United States of Hawaii and the Philippine Islands; (2) the construction of the Trans-Siberian Railway; (3) the expansion of steam-carrying trade on the Pacific; (4) the opening of China; (5) the definite assurance of a Panama Canal by the United States. These changes mean new markets for us, with better and cheaper facilities of transportation. The location of Manila makes it the logical collecting point for all articles of trade in southern Asia except tea, and under American control, with changed conditions of shipping, this city is destined to become a great commercial emporium. The fact that our factories are located on the Atlantic coast has placed us at a disadvantage in the oriental trade. This condition will be greatly alleviated by the construction of the Panama Canal; not to mention the advantages we shall gain in our trade on the west coast of South America. Indeed, the trade of that group of countries lying south of us is important. They buy of us manufactures and food-products. Their principal employment being agriculture, they form one of the most important groups of those nations known to political economists as "neutral markets." In recent years special efforts have been made to cultivate the South American trade. Witness, for instance, the assembling of the International American Conference, under act of our Congress for the explicit purpose of extending inter-American trade; the completion by an American company of telegraphic communication with the southermost cities of South America; the appointment of an inter-American commission to report on a route for an inter-continental railway; the establishment of the Bureau of American Republics for the publication of information for those engaged in American trade; the unification of customs regulations and the monetary conference to study plans for facilitating inter-American exchange; the unanimous recommendation of all the republics to establish an international American bank, with branches in every American republic; the celebration of treaties of reciprocity and the proposal to establish a permanent inter-American court of arbitration for the settlement of all American disputes; and finally, the opening of our great consuming market to our sister republics by continuing the free admission into the United States of coffee, rubber, nitrate of soda and other products, and by the removal of the duties on hides, sugar and wool. In addition to these means of promoting trade must be mentioned the activity and persistence of our American merchants and manufacturers in advertising their wares, and in this way stimulating the market for them.

Nor have our commercial leaders proved less equal to the demands of international trade in the widest sense. In the trade of the world the United States has taken an important place. In fact, the development of our foreign commerce has been almost phenomenal. It is interesting to examine the figures giving the total values of our imports and exports by stated periods for the past fifty years, and to note the rate of increase:

Imports.

1855	$257,808,708
1865	238,745,580
1875	533,005,436
1885	577,527,329
1895	731,969,965
1905	1,117,512,629
1910	1,557,819,988

Exports.

1855	$218,909,503
1865	166,029.303
1875	513,442,711
1885	742,189,755
1895	807,538,165
1905	1,518,561,720
1910	1,744,984,720

With few exceptions the volume of our foreign trade has increased steadily year by year, the figures for the fiscal year 1910 showing the largest imports and exports. For the fiscal year 1910 the imports and exports were $1,557,819,988 and $1,744,984,720, respectively. The gain of $440,000 in imports alone is almost twice the total volume of our foreign commerce in 1812, the year in which the United States first made a clear start in the race for recognition as a world power.

The gradual increase of exports over imports is noteworthy and important. Roughly, from 1855 to 1910 imports have increased fourfold, while exports have increased sevenfold. Whereas in 1855 there was a trade-balance of $40,000,000 against us, in 1905 there was a balance of $400,000,000 in our favor. It is further significant that about half of our imports are manufacturers' materials. See Commerce; Commerce, Interstate; Commercial Organizations; Commercial Treaties; Exports and Imports, American; Exports and Imports of the Latin-American Republics; Alaska, Commercial; Canada, Commerce, Tariffs and Transportation; United States: Foreign Commerce of; History of the Tariff; Reciprocity; Commercial Development; Finances of the, Etc.; Free Trade; Balance of Trade.

Foreign Wars, Military Order of, a national patriotic society founded in 1894 in New York, under the name of the Military and Naval Order of the United States, but known from 1895 by its present designation. The objects of this order are (1) to preserve and honor the memory of those who assisted in the maintenance of the government of the United States in the Revolution, the war with Tripoli, the War of 1812, the Mexican war, and the Spanish-American war; and (2) to collect all records and documents appertaining to the wars above mentioned. The order is sub-divided into 22 State commanderies, and includes in its membership commissioned officers of the army, navy, or marine corps who took part in any of these wars (Veteran Companions), and direct lineal descendants of commissioned officers in the main line (Hereditary Companions). The present membership exceeds 1,600.

Fore'lands, North and South, two headlands on the southeast coast of England, county of Kent. North Foreland projects into the sea in the form of a bastion, and consists of chalky cliffs nearly 200 feet high. South Foreland consists also of chalky cliffs, and has two lighthouses, with fixed lights, erected upon it.

Forensic Medicine. See Medical Jurisprudence.

Foreordination, or **Predestination,** a term appropriated by theology; in the Calvinistic system, the assignment of the Deity, at the time of creation, of some of his creatures to eternal life and happiness and others to eternal death or suffering. Of course the decree was not, as usually stated, irrespective of the spiritual merits of the subjects; but if human beings it was irrespective of their actual conduct on earth. This was supposed to be irrelevant, as through the fall of Adam they had lost all possibility of merit, and owed any escape they might have from utter destruction to God's grace and Christ's vicarious atonement, which restored some of them to moral health. As none of them deserved anything, there could be no injustice in leaving such as he chose to suffer the penalty assigned. The first noun or its verb is not taken from the Scriptures, which uses "ordain" instead (Acts xiii. 48; Jude iv. 13). It was not alone Adam's dereliction which had caused this liberty of choice, however, as angels were included: the Westminster Confession says, "By the decree of God, for the manifestation of his glory, some men and angels are predestinated unto everlasting life, and others foreordained to everlasting death." This implies that no created being has any claim to other than destruction except by divine grace.

Foreshortening, in art, the method of drawing in strict accordance with the rules of perspective, by which objects are so represented as to convey to the observer an idea of their just length, although but a portion of that length is actually given. The method was known to the ancients, and in more recent times has been notably employed by Correggio.

Forest-fly, the British name for the minute parasitic, flea-like flies called bird-ticks, bat-ticks, and the like, in America; specifically *Hippobosca equina*, which is especially a torment to horses by thrusting its long beak through the skin and sucking the blood. See Bird-tick.

Foresters, Ancient Order of, a fraternal order founded 1745, at Yorkshire, England, with a membership 1910 of over 1,300,000, divided among 9,000 courts. The order was introduced into the United States in 1832, and despite the fact that over 175,000 members withdrew and organized the Foresters of America in 1895, the order in this country has a membership of 42,000.

Foresters of America, a fraternal, benevolent order known under this title since September 1895. Originally the order was part of the Ancient Order of Foresters (1745), but freed itself from the High Court of England (1889), and became a separate order. There were 1,890 courts in 1910, with a membership of 231,996.

Foresters, The Independent Order of, was organized in 1874 in New Jersey. It was reorganized in Canada by the Hon. Dr. Oronhyatekha, a full-blooded Mohawk Indian of scholarly distinction, high character, and great ability, who was educated under the patronage of the late king of England, in 1881. In 1881 the society consisted of 369 members and was in debt. It now numbers 235,800 and has a surplus of $6,700,000 in its treasury, having already paid to widows and orphans of deceased brethren about $29,122,000. The membership extends throughout all of the provinces of Canada, nearly all of the States of the American Union, England, Ireland, Scotland, Wales, Norway, Denmark, France, Belgium, India, Newfoundland, and Australia. In 1902 it added to its membership 13,000, and for the first half of 1903 its net increase was about 9,000. During the year 1902 the number of members initiated was 100 per month greater than in 1901. The death rate of the year was 6.60 per 1,000 or a fraction less than the year before. The average age of its membership at the close of 1902 was a little over 36. The society rejects a large percentage of applicants, being very careful in the selection of its risks. Its accumulated funds increased during 1902 by $957,239. This meant a betterment in assets of 18.19 per cent. The increase in assurance at risk during the year was 4.52 per cent. The increase in the premium income of the order in 1902 was 8.37, while the demands upon that income for the purpose of meeting claims was only 1 per cent greater than in 1901. The order is governed by a supreme body, which meets once in three years. The local jurisdictions are governed by high courts of the various States and Provinces. The funds, however, are all forwarded to the head office, there being invested under the insurance law of Canada which prevents investment in anything except first-class gilt-edge securities. The last reports show that no losses have ever been made in investments. The head office of the order is in Toronto, Canada, the building being a magnificent structure known as the Temple Building, which was built and is owned by the order. In addition to the head office it contains a number of banks, loan companies, insurance companies, and is the headquarters of masonry for the city of Toronto. The order pays out daily (1903) $6,500 to widows and orphans. The rates of premium may be judged from the following: Age 35; amount $1,000; mortuary premium $1.38 (small court dues in addition). All premiums cease at 70 years of age, or at any time when the members become totally and permanently disabled, at which time they are allowed to take in cash one half of the amount of their policy, the balance to be paid to their heirs at death. After 70 years of age members are permitted to draw one tenth of their policy for each of 10 years if they live so long, the balance to go to their beneficiaries at death. The order also has a sick and funeral benefit division. It admits lady members, these being called companions, who are gathered in separate courts. Of its total membership of 235,800 about 20,000 are companion members. The growth and progress of the institution is the life work of Hon. Dr. Oronhyatekha. He has been supreme chief ranger for 22 years and is a man of wonderful strength and power. Associated with him are the following: Hon. Judge Wedderburn, Hampton, N. B.; J. D. Clark, Dayton, Ohio; John A. McGillivray, K. C., Toronto, Ont.; H. A. Collins, Toronto, Ont.; T. Millman, M.D., M.R.C.S., Toronto, Ont.: Hon. Elliot G. Stevenson, Detroit, Mich. Benj. Greer, London, Ont., and Charles A. Fitzgerald, Buffalo, N. Y., are the supreme auditors.

Forestry in the United States. Forestry is the art of using the forest continuously to meet the needs of men. In the United States forestry has to do principally with the supply of wood for various purposes, with the maintenance of waterflow in streams, with the prevention of floods, and with the supply of forage for grazing animals within the forest. Nowhere else are forest problems of more vital importance to the welfare of the people than here, and in no other country of similar civilization has so little progress been made in their solution. This condition follows naturally from the vast area of the United States, its comparatively sparse population per square mile, and from the nature, location, and extent of the forests themselves.

The forests of the United States occupy an area of approximately 1,100,000 square miles, or about 36 per cent of the total land surface. They may be divided into five principal regions.

(*a*) The *Northern Pine Forest* extends from western Minnesota east to the Atlantic Ocean and southward to middle Tennessee, northern Georgia, central Virginia, and northern Maryland. Its characteristic tree is the white pine (*Pinus strobus*, Linn.), a tree of the very first commercial importance, which has hitherto supplied much more of the lumber cut in the United States than any other tree. In its western and more important centre of distribution in Michigan, Wisconsin, and Minnesota, the white pine is found both in pure stands and associated with other, principally hardwood, trees. The cut of white pine in the northern pineries reached its maximum in 1890, when the production for Michigan, Wisconsin, and Minnesota was 8,597,623,000 feet. During the census year 1900 the cut had fallen to 5,419,333,000 feet. This reduction in the cut has been accompanied by so marked a fall in the quality of the lumber that at present very many mills are sawing logs of which 50 or 60 are required to produce 1,000 feet of lumber, while the former average of logs to the thousand was seven or less. In the eastern part of the Northern Pine Forest red spruce (*Picea rubens*, Sarg.) is now the principal lumber tree, since the majority of the merchantable pine has been removed. The spruce grows usually in mixture with hardwood trees such as birch, beech, and maple. Formerly used mainly for lumber, spruce is now cut principally for paper pulp. The production of spruce pulp wood in the census year 1900 was 1,160,118 cords, the majority of which was used for news and other coarse grades of paper. In its southern extension the white pine forest penetrates the extensive hardwood belt of the Southern Appalachians, into which it merges as the white pine and its associates cease to be the characteristic trees. In its northern portion the white pine forest is predominantly of value for the production of wood. Its use as a regulator of stream-flow, while very great, is there far less conspicuous than along its southward extension in the Appalachian Mountains, and in many other forest regions of the United States. The loss from floods in streams which head within this forest in the Southern Appalachian Mountains during a certain period of 12 months ending in 1902 was, according to official estimates, more than $18,000,000. Congress has been asked to undertake the control of these floods by the purchase of lands for a Southern Appalachian forest reserve, but the plan, although thoroughly good, has not yet been carried through.

(*b*) The *Interior Hardwood Forest* follows the southern boundary of the Northern Pine Forest from the edge of the treeless region eastward to the mountains of Virginia and southward along the Appalachian Mountains and the Piedmont region, skirting the northern boundary of the Southern Pine Forest until it meets the prairie in western Texas. Its principal trees are the oaks. It is in this forest that the black walnut, now almost exhausted as a timber tree, reached its best size and most important distribution.

(*c*) The *Southern Pine Forest* extends from northern Maryland south along the Atlantic and Gulf coasts and up the valleys of the principal rivers until it meets the open country in western Texas. Its most important and characteristic tree is the longleaf pine (*Pinus palustris*, Mill.), in many respects the most valuable and important timber pine of the globe. Frequently associated with the longleaf pine, and serving elsewhere to delimit the boundaries of the Southern Pine Forest, is the loblolly or rosemary pine (*Pinus taeda*, Linn.), a tree of rapid growth and great dimensions. Other characteristic trees are the shortleaf pine (*Pinus echinata*, Mill.), which occupies the higher ground back from salt water, and the bald cypress (*Taxodium* *distichum*, Linn.), a swamp and tideland tree of high commercial importance, whose wood, for many purposes, is taking the place of the white pine, as clear lumber from that tree becomes progressively scarcer and higher in price. The cut of pine in the Southern Pine Forest in 1900 was 8,523,000,000 feet, and it is increasing with great rapidity. The cut of cypress in 1900 was 495,000,000 feet. The naval stores produced from the longleaf pine in 1900 were valued at $20,344,888.

Along the western border of the Northern Pine Forest, the Interior Hardwood Forest and the Southern Pine Forest extend the region of the Great Plains, destitute of timber except along the margins of the streams and on occasional elevations. There is a strong probability (and in many places conclusive evidence) that great areas of this region at one time bore trees and are still capable of growing forests. The clothing of such areas again with trees is one of the most important problems to be attacked and solved by the American forester. Ultimate success, of which there is now no doubt, will be of enormous value to a region whose principal industries, agriculture and grazing, are both so dependent for their future development upon a cheap and accessible timber supply.

(*d*) To the west of the Plains region lies the *Rocky Mountain Forest*, occupying more or less isolated mountain chains or mountain masses separated by grazing lands, deserts, or cultivable valleys. The Rocky Mountain Forest has its eastern extensions far in the heart of the Plains country, as in the case of the Black Hills Forest in North Dakota. Its predominant characteristic at middle and lower elevations is semi-aridity, and its distribution is limited by a combination of forest fires and deficient rainfall. Its principal timber trees are the western yellow pine (*Pinus ponderosa*, Laws.), the Engelmann spruce (*Picea engelmanni*, Engel.), the red fir (*Pseudotsuga taxifolia*, Lam., Brit.), and the lodgepole pine (*Pinus murrayana*, "Oreg. com.") The principal products of the Rocky Mountain Forest are water, wood, and grass, in the order named. The chief industry of this region is, or is about to become, irrigated agriculture. Since the passage of the National Reclamation Act of 1902, which provides for the reclamation of vast areas of irrigable arid land under the auspices of the Federal government, the watersheds of the region have taken first place in its economic resources, for here water, not land, is the measure of value of the farm. All the industries of this region hang with peculiar dependence upon the forest. The distance from which supplies of timber for mining, for railroads, and for domestic purposes must come if the Rocky Mountain forests are once exhausted makes their preservation an imperative necessity on these accounts, while the existence of summer range in the forest for herds of cattle, sheep, and horses gives value to immense areas of winter range which without it would be of little use, and thus maintains one of the most important industries of the region. Because of the aridity of the country the forests of the Rock Mountain region are destroyed with peculiar facility by fire, by overgrazing, and by overcutting. The reproduction is less rapid and abundant than on either the eastern or western coast, while the preservation of the forest, of vast importance everywhere throughout the United States, is here more peculiarly and immediately essential to the well-being of the people than is the case elsewhere.

(*e*) West of the Rocky Mountain Forest stretches the *Pacific Coast Forest*, probably the most densely timbered and prolific forest region of the earth. In California the forest of the Sierras, characterized by the big tree (*Sequoia gigantea*, Decaisne), the sugar pine (*Pinus lambertiana*, Dougl.), and numerous magnificent firs, is perhaps the most beautiful and attractive in existence, while the forest of coast redwood (*Sequoia sempervirens*, Lamb., Endl.) has a larger stand of merchantable timber per acre than any similar area of which we have knowledge. In Oregon and Washington, the red fir (*Pseudotsuga taxifolia*, Lam., Brit.), the coast cedar (*Thuya gigantea*, Nutt.), and the tideland spruce (*Picea sitchensis*, Bong., Trautv. and Mayer) are lumber trees of the highest commercial value and the chief economic components of the forest, while the coast hemlock (*Tsuga mertensiana*), for the present less sought after than the fir, and the red fir itself alternate as the most numerous tree in the forest. Water is the most important product of the Sierra forest, wood of the redwood belt and of the coast forests of Washington and Oregon. The cut of redwood in 1900 was 360,000,000 feet, the lumber product of Oregon 740,000,000 feet, and that of Washington 2,300,000,000 feet. During the year 1902 the loss from fire in the State of Washington was said to be about twice the cut. Although it is true that wood is by far the most important product of the coast forests of Washington and Oregon, yet the prevention of floods from the heavy rainfall and snowfall of the coast is of critical importance to many agricultural valleys.

Forests of the Philippine Islands.— The forest lands of the Philippine Islands cover an area which certainly exceeds 40,000,000 acres. They are rich both in the number and in the value of their species, and their total stand of merchantable timber is exceedingly large. Except for occasional private or monastic holdings, they are entirely in the possession of the United States, and are being administered by an Insular Bureau of Forestry in competent and reliable hands. The development of practical and systematic forestry in the Philippines is likely to be even more rapid than in the United States, and the returns from the government forests there, already more than double the expense of administration, will form one of the most important sources of revenue from the islands.

Forest Protection.— The early settlers in New England and Pennsylvania, coming as they did from regions where forest protection was rigidly enforced for the sake of the game, brought with them the survival of their habits at home, and made provision among their earlier laws for the preservation of the forest. This transplanted care for the woodlands did not long survive either in legislative or in effective public desire. It was succeeded by a reasonable appreciation that the forest, in the early days on the Atlantic Coast, was the enemy of the settler. The state of mind which was thus produced survived in enmity to the forest long after the progress of civilization had converted it from an enemy of the settler to his best friend, and the eagerness for forest destruction which has characterized the great majority of frontier com-

1. Southern Appalachian Forest. Absence of large trees shows this is cut-over land.

2. Cascade Forest Reserve. A clearing of mixed forest showing restocking of 40,000 young trees per acre.

munities in the United States has, after the early days, had no more legitimate cause. Until the immense expansion of the railroads which followed the close of the Civil War, the demand for timber was comparatively local in character, and the great operations of destructive lumbering had not begun. Since that time forest destruction has increased progressively until the exhaustion of the timber supply has almost been accomplished in certain regions and is imminently threatening elsewhere. Even before the era of gigantic lumbering operations, organized bodies began to take action for the preservation of the forest, but it was not until the resolutions of the American Association for the Advancement of Science in 1873 that such action achieved results. These resolutions called upon the National government to investigate the forest situation of the United States and to move accordingly. In 1876 the Commissioner of Agriculture, through Dr. Franklin B. Hough, one of the most honored pioneers of forestry in this country, organized such an inquiry. The work which Dr. Hough then began developed into the Division of Forestry in the United States Department of Agriculture, which division was greatly enlarged and became the Bureau of Forestry in 1901.

The Bureau of Forestry (now the Forest Service).—This is divided into six offices. The Office of Forest Management prepares working plans for conservative lumbering for the National forest reserves (see below) and for State and private forest holdings. Its practical assistance to the owners of timberlands is given on the ground, either without cost in the case of small areas, or at the cost to the owner of expenses only in the case of larger tracts. The area of private forest land for which applications for assistance had been made on 1 July 1903 was 5,656,171 acres, an area far larger than the force of the Office of Forest Management has been able to cover. The total area of private lands put under management at the same date was 679,194 acres. The Office of Forest Extension gives assistance in tree planting under conditions similar to those described for the Office of Forest Management, studies methods of re-establishing the forest on areas which it once occupied, and gives special attention to the study and prevention of forest fires. On 1 July 1903 the area for which planting plans had been made amounted to 10,807.47 acres. The Office of Forest Measurements calculates, drafts, and puts into final form the very extensive measurements and maps made in the field by the Offices of Forest Management and Forest Extension. The Office of Forest Products studies the uses of timber and other forest products, makes timber tests and chemical examinations of by-products of the forest, and gives special attention to the preservation of wood. The Office of Dendrology deals with the natural history and nomenclature of trees and forests, and has charge of the forest library and the collection of forest photographs of the United States. The Office of Records is charged with the routine and the business operations of the Bureau. The appropriation of the Bureau of Forestry for the year ending 30 June 1904 was $350,000. It will be evident from what has been said that the work of the Bureau is to forward both the study of the forests of the United States and the application of practical forestry upon them regardless of the character of their ownership.

National Forest Reserves.— Parallel with the development of the Bureau of Forestry, two other lines of National forest work have sprung up, one in the General Land Office, the other in the United States Geological Survey. To the General Land Office the custody and disposal of the lands of the public domain have been given, together with the care and management of the National forest reserves created from time to time by proclamation of the President of the United States under the Act of 3 March 1891. These reserves, situated in all the Western States and Territories except Nevada, occupied on 1 July 1903 an area of 62,343,645 acres. When the first reserves were created, it was natural that their administration should be placed in the hands of the Land Office, which had had charge of these lands before they were reserved, but the development of the other government forest work has made it evident that a change is required.

In 1895 the president of the National Academy of Sciences was requested by the secretary of the interior to appoint a committee to examine the forest lands of the public domain and report a policy for their management. Upon the recommendation of this committee, President Cleveland, on 22 Feb. 1897 created some 22,000,000 acres of forest reserves. The proclamation of these reserves was immediately followed by protests in the Western States and Territories so vigorous that Congress suspended the operation of the President's proclamation for a year in all the States affected except California, whose senators, recognizing the value of reserves to their State, protested against the suspension. At the expiration of the year of suspension the proclamation of President Cleveland became effective in spite of some opposition in the West, and the forest policy of the government has never been seriously threatened since that time. The law of 3 June 1897 conferred upon the secretary of the interior all necessary powers for the management of the forest reserves through the General Land Office, and gave to the director of the Geological Survey, who had been instrumental both in saving the reserves from permanent suspension and in procuring the passage of the law, certain duties in connection with them. He was charged with the survey and description of the reserves, with mapping their topography and timber, and with recommending to the secretary of the interior their proper boundaries and marking them permanently upon the ground. The duplication of work and the loss of energy involved in the dispersion of the National forest work under these three independent agencies has been called to the attention of the Congress by the President of the United States and is likely soon to come to an end.

State Forestry.— While the national government was making the progress described, various States were taking active measures in forestry. Among those Minnesota and Pennsylvania are conspicuous for the excellence of their fire laws, New York and Pennsylvania for their forest reserves, Michigan, California, and a few other States for peculiar excellencies of State organization or public sentiment on the forest question, but except in some of the States already named and a few others the state movements for forest protection have not usually been notable either for efficiency or good results.

Forest Schools.— Instruction in forestry began in this country under the mistaken impression that forestry differs but little from horticulture and botany. But the character of forest teaching has been revolutionized within the last few years, and at present opportunity for education in professional forestry is not wanting in the United States. One of the earliest practical courses of forestry, discontinued shortly after it began, was given in the State University at Bozeman, Montana, under Capt. George P. Ahern, U. S. A., now in charge of the Bureau of Forestry in the Philippine Islands, but the first effort toward the establishment of professional instruction was in the simultaneous opening in the autumn of 1898 of the Biltmore Forest School at Biltmore, North Carolina, and the New York State College of Forestry as a part of Cornell University. The former offered a one year course without entrance examination and is still continuing to do so. The Cornell School, which offered a four year undergraduate training in professional forestry and had begun to graduate students capable of passing the government examinations, was discontinued in 1903. The Yale Forest School, which offers a two year post graduate course to the holders of a bachelor's degree from any recognized institution of learning, was established in 1900. It has already graduated more professional foresters than all other schools combined. The University of Michigan has just instituted a two year post graduate course, the University of Nebraska has established a four year undergraduate course, the State Agricultural College of Minnesota has established a four year course; Harvard University offers some instruction in forestry in the Lawrence Scientific School, and many other institutions afford the opportunity for more or less complete and effective training in various branches of forestry.

American Forestry Association.— The American Forestry Association, organized in 1882 as the American Forestry Congress, has been one of the most effective agencies in the progress of forestry and forest preservation in the United States. Its influence upon legislation has of late years been a notable one, and its summer meetings, held in whatever portion of the country needs its influence most, have been exceedingly effective in educating public opinion. Its official organ, formerly 'The Forester,' now called 'Forestry and Irrigation' because it has become likewise the organ of the National Irrigation Association, is the best forest periodical in the United States and one of the best in existence. In the publicity which it gives to forestry, it has been of late most cordially and helpfully joined by the lumber journals and the daily press of the country. The newspaper press as a whole has been a most effective agent in the dissemination of right ideas of forestry and in bringing about in Congress, among lumbermen, and among the people at large the strong support of practical forestry which is now perhaps the most hopeful sign of the forest situation in the United States.

The Practice of Forestry.— The practice of forestry in the United States naturally falls under two heads: First, those forms of conservative lumbering which were practised by farmers, lumbermen, and others without the assistance of professional foresters. Second, those forms of conservative lumbering which have been introduced under the supervision of the latter. In both cases a factor of the utmost importance is found in the methods of logging adopted or devised by the American lumbermen in different parts of the country.

Destructive Lumbering.— The methods of felling timber, except for variations in the forms of axe and saw, are approximately similar throughout the world, but the methods of handling the felled timber vary greatly. In the United States the mechanical and inventive capacity of the people has led them to develop forms of logging cheaper and more effective than those in use elsewhere. These methods have become highly specialized in response to the requirements of the market, the topography, and the forest itself in the different forest regions. In the Northern Pine Forest the final operations of logging await the fall of sufficient snow to make possible the preparation of solid ice roads over which the logs can be hauled to the bank of a stream or to the railroad. In the Southern Pine Forest and throughout the larger part of the interior hardwood region snow is not a factor in the logging. Its place is taken to some degree by timber slides or by installations of wire rope cables which drag or carry the logs from the stump to a logging train. In the Rocky Mountain region the methods vary greatly, but on the whole they are less highly developed there than in the denser timber on the Pacific slope, where wire rope logging has reached a very high point of economy and efficiency. Here the logs are dragged over specially prepared skid roads by wire cables of great length attached to the drums of donkey engines, which transport themselves about the woods by their own power whenever change of location is required. Forestry being in many respects more closely akin to lumbering than to any other occupation, it is of first importance to the forester that effective and economic methods of logging should be employed. These methods hitherto have been wasteful and destructive both to an unnecessary and to an unprofitable degree, and the future of the forest has been needlessly sacrificed to the idea of immediate gain. Conservative lumbering harvests the present forest crop economically and profitably at the same time that it provides for future growth.

Forestry by Private Owners.— The idea of perpetuating the forest by wise use, which is the essence of forestry, had found hospitable lodgment in the minds of many Americans before forestry had become a recognized profession in the United States. Examples of the treatment of the forest from this point of view were more common in the northern spruce forests than elsewhere, and especially on the Androscoggin River in Maine, where great permanent value was given to very considerable tracts of spruce land by careful handling. Among the farmers of New England, New York, and New Jersey the harvesting of successive crops of hardwood sprouts for fuel, fencing, etc., was a common practice during the last century, but as a rule the methods used, like those for the spruce in Maine, were less effective than they might easily have been.

Beginnings of Professional Forestry.— In 1891 the first example of professional forest management in the United States was begun on the Biltmore estate near Asheville, North Carolina, in a mixed forest of hardwood and pines which had been severely damaged by the mismanagement of former owners. The object of the management was to secure what revenue was possible from the forest while conducting such operations as were required to put it in good condition. Even in the first year the forest work paid for itself, and it has been conducted successfully ever since. No further examples of professional forest management were created until, in the summer of 1898, practical forestry was introduced, under the care of the then Division of Forestry of the Department of Agriculture, on two tracts in the Adirondacks of a total area of more than 100,000 acres. Other instructive examples of co-operation in practical forestry between private owners and the government have been created in Maine, Tennessee, Georgia, Texas, and many other States and Territories, and the plan is still in increasingly effective operation. Under it the great majority of the conservative forest management now in existence in the United States has been brought about. The types of practical forestry which have been adopted or devised for application in these various cases include improvement cuttings of various degrees of refinement, several types of treatment of sprout lands, and a variety of forms of the high forest and selection systems, the most typically American of which is what is called localized selection. In all cases their application has been reduced to the utmost simplicity, and a definite effort has been made to limit interference with the ordinary methods of logging to the smallest possible amount. As a result they have not interfered as a rule with the profits of the forest, while the reproduction and perpetuation of the forest, the other principal object of the management, has been fully secured. Through the application of these simple and effective methods forms of forest management peculiarly adapted to American conditions are growing up. In the early practice of American foresters many of the important tenets of European forestry, such as the doctrine of the sustained annual yield, have wisely and necessarily been abandoned; and effort has been confined to insuring the profitable use of the forest and its continuance in productive condition, not seldom at the expense of a long hiatus in the yield, provided such a form of management was satisfactory to the owner. The conditions of the lumber trade here justify the transportation of forest products for longer distances than is possible in Europe, and localities are far less dependent in America upon the local supply than is the case abroad. A fundamental consideration in determining forms of management in the United States is the extremely moderate price of low grade forest products such as firewood and the cheaper kinds of lumber. This fact, together with the cost of transportation, decides what kinds and grades of timber can be profitably cut and how closely what is cut can be put to use. Logging under the conditions of which not more than 50 per cent of the growing tree ever reaches the market, is still practised in several parts of the United States. The duty of perpetuating the forest is not less imperative under such conditions than where the price of lumber is higher. The methods of the American forester, although they must be the product of ripe training and experience if they are to succeed, are often summary and rough. In every case they must pay and in every case they must insure the perpetuity of the forest. If they succeed in these two essentials, their roughness may be disregarded.

Principal Forest Problems.— The efforts of American foresters are at the present time largely grouped about a few principal forest problems which arise from the nature of the forest, from the dangers which threaten it, and from the economic conditions by which it is surrounded.

The National Forest Reserves.— Since it is the general experience of all countries that the only forests which are permanently safe are those in the hands of a permanent owner, namely the government, the United States has by the creation of forest reserves undertaken to set aside and hold in the public hands those areas within the public domain whose preservation is essential to the public welfare. The establishment of these forest reserves met at the beginning, and in certain instances continues still to meet, unthinking opposition in certain parts of the Western States where lie the 863,000,000 acres which remain of the public lands. But in each State public sentiment is crystallizing rapidly and effectively in favor of forest preservation. This trend of the public mind makes it continually easier for the national government to set aside and hold those forest lands which it should retain, and is rapidly making possible a better administration of the reserves themselves. The latter are located either at the headwaters of streams whose protection is essential to irrigated agriculture on the lands below them, or in more densely forested regions where the preservation of the timber supply is the first consideration. In either case their preservation alone can meet a critical public need. It is unfortunate that the personnel of forest supervisors and forest rangers available for their protection has remained far below their requirements. The natural result has been that the diminution of forest fires, although striking in amount, has been less than might have been accomplished, while the stock ranges have continued to suffer from overgrazing and the reserves have been injured to some extent by timber stealing and by minor depredations. They have nevertheless answered a most important and beneficent public purpose, and under the policy which controls their administration their value to the people will steadily increase. This policy briefly stated is the employment of all their resources for the good of the people, and thus, in the language of President Roosevelt, the making and maintaining of prosperous homes.

Forest Fires.— It is altogether probable that more timber has been destroyed in the United States since the landing of the Pilgrims by fire than by the axe. In every country where timber is plenty and settlers few, fire has been harmfully employed to assist the settler in his warfare against the forest. With the progress of civilization railroads have scattered along their rights of way fires which have destroyed thousands of square miles of timber. The transcontinental railroads are lined for hundreds of miles, where they traverse the forest regions, with the bleached fire-killed remnants of the former stand. Prospectors often set fires in heavily timbered countries to uncover the surface of the mineral soil, and campers, hunters, and others, either by the injudicious location of their fires or by neglect in leaving them unextinguished, have been responsible for much important loss. The use of steam machinery in logging and the supposed necessity for burning away the debris, as in the case of the coast redwood of California before skidding the logs, has been responsible for many fires. The loss from forest fires is confined to no section of the country and its percentage has diminished but little of late years, if at all, in proportion to the total stand of timber which remains. Although exact figures are not obtainable, it probably exceeds on the average a total of $50,000,000 a year. The Hinckley fire of 1894 in Minnesota destroyed property valued at $25,000,000 and cost the lives of 418 persons. For two weeks before the high wind which gave it its destructive power this fire was smoldering in the neighborhood of Hinckley and could have been extinguished easily and cheaply at any time. During the autumn of 1902 fires destroyed property valued at $13,000,000 in the States of Washington and Oregon, while in the spring of 1903 about 650,000 acres were burned over in the Adirondack Forest in New York. Such losses are as unnecessary as they are appalling, for a small fraction of the cost of these fires expended in preventive measures would have rendered their occurrence practically impossible. There is but one effective safeguard against fire in the woods, an enlightened public sentiment with regard to it. Such a sentiment is rapidly being created within and near the National forest reserves and in certain other portions of the country. While the effort to produce it is in progress the National Bureau of Forestry is studying the natural history of forest fires and devising the cheapest and most effective means for extinguishing them. It is studying likewise their effect upon the condition and production of the forest, and the amount of loss, as special means of awakening public opinion. In the dense and moist forests of the northern pine belt, forest fires of importance almost invariably originate in the debris of cut-over lands and not seldom are unable to penetrate the untouched virgin forest. In unusually dry seasons, however, fires may burn throughout any woodlands without distinction, and it is in such seasons that conflagrations like the Hinckley and the Peshtigo fires take place. Except under extraordinary conditions, fires in forests of this type are apt to move slowly, but they are difficult to extinguish because of the mass of inflammable material in the forest floor. Mature trees in the Interior Hardwood Forest and the Southern Pine Forest are seldom killed by fire if the bark is unbroken and sound. Fires in these regions usually travel along the ground with moderate speed and are seldom dangerous to human life. The damage they occasion is in the destruction of young growth and the unsoundness which they produce in trees of larger size. They are especially destructive in those portions of the Southern Pine Forest where the longleaf pine is boxed for the production of naval stores. Where a boxed tree catches fire it is lost for such production, and most often succumbs to the attack. In the Rocky Mountain Forest fires are less uniform in type. Where the timber is dense, and especially where it is composed of a thin-barked species such as the lodgepole pine, not infrequently vast areas of the forest are killed by a single fire. In such cases the trees are not consumed, but stand bleaching long after they have lost their bark, and finally fall in an almost impassable tangle of prostrate trunks, to be consumed later by another fire together with the young growth which has sprung up among them. In the more open forests of the western yellow pine, the damage is to the young growth and to the soundness of the old trees. In many regions it is practically impossible to find a tree of any size that does not bear the marks of fire. The most serious effect of fires in the coast redwood of California is to prevent the sprouting of the old stumps after logging, and thus to convert highly valuable timberland into indifferent pasture. In the fir forests of Oregon and Washington fires are common and difficult to extinguish, but usually slow-burning and not of great extent. It is only in seasons of exceptional dryness that losses of appalling magnitude are to be expected. The State of Washington has recently passed a forest fire law, the operation of which will be watched with peculiar interest.

Some Uses of Wood.—The yearly product of wood in the United States is about 35,000,000,000 feet. In 1900 the lumber industry employed 19,127 wage-earners, to whom it paid $560,022,690. The perpetuation of this industry is of vital concern to all the people. Its ramifications are as wide as the industrial life of the nation, and its perpetuation is a most pressing concern of the forester. The use of wood for the maintenance of railroad tracks, for example, rises to about 120,000,000 ties a year, together with vast amounts of bridge timber, piling, etc. Since the use of metal ties is believed to be impracticable by American railroad engineers, the maintenance of the supply of wooden ties is of vital importance to the railroads, and through them to the nation at large. In a similar way, the permanence and success of the mining industry is dependent upon cheap and accessible supplies of timber. In most portions of the West such supplies can be expected only from the national forest reserves. In the creation of the reserves, therefore, the special needs of mining and other industries have been kept carefully, and it is also believed successfully, in mind.

Summary.—The profession of forestry, which has already reached high standing on the continent of Europe, in British India, and elsewhere, is being born in the United States. Its establishment on a high plane is of the first importance to the solution of every problem of American forestry. The forest wealth of this country, although vastly diminished, is still very great, and the reproductive capacities of its forest are usually of the first grade. Wood is cheap and methods of the lumberman are wasteful. The low cost of transportation permits the movement of forest products from vast distances, so that local markets are supplied from distant points. In view of all these conditions, the task of the American forester is to secure the reproduction of the forest without materially impairing the profit of lumbering, and wherever possible to bring into public ownership whatever forest lands are required to supply in permanence the public need.

GIFFORD PINCHOT.

Forest Park, Ill., village in Cook County; on the Illinois C. and the Chicago & N. W. R.R.'s; about seven miles from Chicago and near Oak Park. The first permanent settlement was made in 1854, and the village of Forest Park was incorporated in 1883. It is a residential suburb of Chicago, and is noted for its race track (see Horse-Racing). Waldheim and Forest Home cemeteries are in Forest Park. A monument to the men executed as anarchists who were connected with Chicago riots of 1886 is in the Waldheim cemetery. The government is vested in a president and board of trustees elected annually. Pop. (1910) 6,594.

Forests, Petrified, fossil remains of forest trees and plants found in the Potsdam sandstone formations in America and the Cambrian rocks of Europe. Large forest trees, fossilized and converted into stone are found in many sections of the United States, particularly west of the Mississippi River. Those of Arizona are well known. Palæobotany.

Forey, Elie Frédéric, ā-lē frā-dā-rīk fō-rā, French military officer · b. Paris, France, 10 Jan. 1804; d. there 20 June 1872. He took part in several Algerian campaigns as well as in the Crimean and Sardinian wars, and when the expedition to Mexico was decided upon in 1861, Forey received the command of the French troops. After several sanguinary engagements he attacked and stormed the strong post of Puebla, thereby throwing open the road to the city of Mexico. For this service he was made marshal of France.

Forfeiture, fôr'fit-ūre, a legal penalty, by which an owner is absolutely deprived of his property for crime or other unlawful act. This applies to personal as well as real property, and forfeiture may be a decree of civil as well as criminal courts. The penalty is of feudal origin. The lord owed protection to the life and property of the vassal; the latter owed fealty and service to his lord. When the vassal failed to yield these, he lost the shelter of the law, became an outlaw, and incapable of holding property. Loyalty to the feudal relation being the condition on which life and property were secured to him, when he failed in loyalty he had no longer any claim on life or property.

Treason was punished by forfeiture long before the Norman Conquest in 1066. After that period forfeiture became the ordinary penalty for felony, which was styled petty treason; while treason, or disloyalty in regard to the sovereign, was called high treason. Forfeiture was accompanied by what was styled corruption of blood. This was the sentence of legal bastardy passed on the offender so that he could neither inherit nor bequeath property.

Felony in the United States has never been considered ground for forfeiture. The Federal and State laws have modified all precedents in the matter of forfeiture, which they restrict within very narrow limitations. See Attainder.

In England civil forfeiture may be incurred by tortious alienation, by wrongful disclaimer, by alienation in mortmain (see Mortmain), by breach of condition, and by the commission of waste (see Waste). In Scotland civil forfeiture may arise either from statutory enactment, at common law, or by agreement. In the United States civil forfeiture is only imposed for acts of waste committed by tenants for life or years, or for breach of contract in violating the conditions on which lands were granted. Some States have abolished even this degree of forfeiture. By particular statutes enacted by Congress smuggling, or importing goods on fraudulent invoices involve confiscation, and forfeiture of the entire invoice. (See Invoice), or the balance wrongly imported. Piracy has always entailed confiscation or forfeiture of the piratical craft.

Forge, Forging, and Forging Machines. A forge is a furnace or open fireplace, having a forced draft, for heating metals, especially iron and steel, to be shaped by hammering or pressure. Previous to the 19th century, most iron work was forged by smiths on anvils. The coal used now is usually soft, and is sometimes termed blacksmith's coal. Portable forges are made for light work, and a common form of these has four legs made of iron tubing, a shallow bowl to hold the coal and contain the fire, and a hood above. At the rear is a small rotary fan; operable by a wheel-crank. As forges increase in size and capacity, they develop into what are more properly called furnaces, such as the immense heating furnace of a steel works. In forging iron by hand the smith thrusts the metal into the centre of his fire, and its color tells him when it is ready to be worked. As it heats, it becomes black red, then a low red, then bright red, then a white heat, and if the heating continues it next begins to burn. If the smith desires the iron to be very soft, that it may yield quickly to his blows, he lets it come to a white heat, then takes it with his tongs on to his anvil, and begins to hammer it rapidly into the desired shape. Often a helper stands by to strike blows alternately with the smith, in order that as much hammering as possible may be done before the iron cools to a point where it requires reheating. Long practice makes very expert smiths, and many of them will shape a bar of iron into intricate form in a surprisingly short space of time. When the smith desires to weld together two pieces of iron, he must heat both pieces at the same time to a uniform white heat. As the iron approaches a white heat he throws sand on it, which, if done at the proper temperature, adheres and melts, forming a liquid glass-like fluid that flows over the surface of the iron and keeps the air from it, thus preventing its burning. If the ends of two bars are to be welded, each is first brought to a flat point, so that there will be considerable surface to weld together. After the surfaces adhere, the weld may be reduced by reheating and hammering down to the size of the other portions of the bars. When pieces are joined end to end, this is termed a butt-weld, which is not apt to be as strong as a lap-weld. Where forgings are so large that a smith and helper cannot work them satisfactorily, because there is too much and too heavy hammering to be accomplished in the short time the metal retains its great heat, the machine hammer is resorted to. This was made in various forms, and was an important tool during the early part of the 19th century, finding its culmination in the great steam-hammer of Neysmith, which was devised especially for such large forgings as the shafts of paddle-wheel steamships, then coming into use. The trip-hammer and the steam-hammer were the chief tools used for large forgings until about 1890 when the hydraulic press began to supersede the hammer for large work. About 1884, when the United States government began to seriously take up the rebuilding of the navy, and the construction of steel battleships and cruisers, there came a demand to American manufacturers for very large forgings, which had not previously been produced here. The forges of that date were equipped with power hammers, of a capacity suited to welding wrought iron into forgings of moderate size. The introduction of steel rails taught American iron manufacturers that steel forgings were desirable in all classes of machinery, as greatly reducing the size of the parts, because of the increased strength.

The hydraulic compression system of forging, which was introduced in America when our steel plants were called upon to provide the large forgings for the navy, has met with general approval, and is steadily increasing in use. It has been demonstrated that forgings made by hammering were subject to all sorts of internal strains due to differences in compression and differences in cooling. When such a forging is cut, as for making a keyseat, a distortion of form follows as the result of certain strains that have been relieved. A large forging requires a pressure great enough to penetrate to every part of the mass of metal, so that the flow of metal resulting shall take place uniformly throughout. Such a flow requires time and a pressure that can not be obtained by a quick hammer blow, and a series of blows does not produce the same effect as does the persistent pressure of the hydraulic forging machine. Fluid steel begins to crystallize at the point where the degree of heat is reduced so that it solidifies (about 2,600° F.), and the more slowly it is cooled from this point downward, the larger will be the crystals of the ingot. Forging during the cooling tends to check crystallization, just as stirring water at a temperature below the freezing point would check the formation of ice crystals. The more irregular the method of forging is, as in the case of hammer blows, the more it interferes with an even crystallization. The pressure system not only interferes much less than hammering, but forgings are farther improved in modern practice, by reheating above the recalescent point, which is between 1,200 and 1,300° F., depending on the percentage of carbon and annealing to secure a new crystallization, and oil tempering.

An examination of the grain or fibre of hydraulic forgings shows that the steel tends to arrange itself in layers following the outer contour of the piece of metal, thus securing the most strength. A sharp angle in the pattern will tend to cut off the flow of metal, and if such is required, the method is to round out the place in the forging, to secure the best flow of metal, and then machine off the surplus later.

To avoid internal strains as much as possible such large forgings as steamship shafts are preferably made hollow. That is to say, the cylindrical ingot from the furnace after cooling is bored through the centre, mounted on a steel mandrel, heated and forged by compression. Ingots produced with fluid compression are well adapted to being bored and hollow-forged, and this method produces the most perfect forgings. These large forgings are subjected to a hydraulic pressure of about 7,000 pounds to the square inch, which pressure is maintained while the mass slowly cools. Shafts of more than a foot diameter are best bored, as the bore hole not only assists uniform heating, but gives opportunity for inspection.

Small forgings of iron, steel and other metals are now most commonly produced by the method known as drop-forging. A press containing a top and bottom pattern (die and counter) receives the roughly shaped hot metal, and at a single blow brings it to the desired shape. Parts of machines that were formerly made of cast iron or steel are now drop-forged at moderate cost, and the metal is so much stronger that they can be lightened materially in weight, thus sometimes actually reducing the cost, while increasing the durability. See Bellows; Furnace; Hammer; Iron; Press; Steel; Welding.

Charles H. Cochrane.

Forgery, the fraudulent making or alteration of a writing to the prejudice of another man's rights, or making of any written instrument for the purpose of fraud and deceit; the word *making*, in this last definition, being considered as including every alteration of or addition to a true instrument. The offense of forgery may be complete though there be no publication or uttering of the forged instrument; for the very making with a fraudulent intention, and without lawful authority, of any instrument which, at common law or by statute, is the subject of forgery, is of itself a sufficient completion of the offense before publication. Most of the statutes, however, which relate to forgery make the publication of the forged instrument, with knowledge of the fact, a substantive offense. A deed forged in the name of a person who never had existence is forgery at law. A writing is forged when a person drawing up a will for an invalid, inserts legacies therein falsely. It is not material whether a forged instrument be drawn in such manner that if it were in truth that which it counterfeits it would be valid. The punishment of forgery at common law is, as for a misdemeanor, by fine, imprisonment, and such other corporeal punishment as the court in its discretion might award. The penalty varies in different States, in some the statutes having been much enlarged to include acts which were not punishable formerly as forgery. The punishments ordained for the offense by the statute law in England were once, with scarcely an exception, capital.

Forli, Melozzo da, mā lōts'ō dă fŏr lē', Italian painter: b. Forli, about 1438; d. 1494. He was the first who applied the art of foreshortening to the paintings of vaulted ceilings About 1472 he painted the 'Ascension' in the great chapel of the Santi Apostoli at Rome for Cardinal Riavio. In 1711, when the chapel was being rebuilt, this painting was cut out of the ceiling and placed in the Quirinal palace, where it still remains.

Form, in philosophy, a term used (1) objectively, to denote the assemblage of qualities which makes a thing what it is. Only the essential and permanent is considered, the accidental or adventitious being disregarded. The word is employed also (2) subjectively, to express the idea which the mind may supply of an object, as distinguished from that object as it is in itself. In this sense it is peculiar to the philosophy of Kant, who postulated two such ideas, namely space and time, supplied to the object by the mind through the operation of experience.

In botany, the term used to designate the unit of ecology, as that division of the study which treats of the relations existing between plants and their environments is now called. The word is frequently met with in such combinations as “form of vegetation” or “plant form.” See BIONOMICS; PLANT GEOGRAPHY.

In music, that theory in the general art of composition in accordance with which themes, tonalities, phrases, and sections are so arranged as to obtain a correlated and symmetrical whole. The principal three recognized forms are those of the *lied*, *rondo*, and *sonata*. These admit of numerous variations. In so-called cyclical forms, as, for example, the symphony, the necessary correlation and symmetry is secured by the relation of the movements as to proportion and key, the succession of various tempi, and sometimes also the employment in one movement of a theme previously used in another.

Formâ Pauperis, fôr'ma pâ'pėr-is, **In,** signifying — in the character of a poor person — is the legal term both in Great Britain and the United States for suits carried on by individuals who are too poor to pay the usual fees. As early as the reign of Henry VII., a statute provided that any one taking oath that he was not worth £5 beyond his wearing-apparel and the subject in dispute, was entitled to have writs, according to the nature of the case, without paying fees, and the judges were to assign him counsel and attorney who should act gratuitously. This indulgence is granted to plaintiffs only at common law, and is granted to defendants only in prosecutions. A plaintiff must have a counsel's certificate of a good cause of action, and an affidavit of the party or his attorney must be laid before court that the case contains a full and true statement of material facts. A person admitted to sue *in formâ pauperis* is not entitled to costs from the opposite party, unless by order of the court or of a judge. In several of the United States the provision is governed by statute, while in others it is considered part of the common law.

Formaldehyde. See BACTERICIDE; DISINFECTANTS; FUMIGATION.

Form'alin, a solution produced by dissolving in 60 per cent of water 40 per cent of what is known as formaldehyde gas, CH_2O. This solution has hitherto been looked upon as a powerful disinfectant. Dr. Charles C. Barrows has recently employed formalin as a specific for sepsis or blood poisoning. The patient was a colored woman, 26 years of age, who was on the point of death; the virulent bacteria of septicæmia, streptococci, had been recognized in her blood, her pulse ranged from 150 to 160 and her temperature was 108. Into one of the large veins of the right arm an attempt was made to inject one litre of formalin solution of the strength of one part of formalin to one thousand parts of water. About 500 cubic centimetres of the solution found its way into the circulation. The temperature fell almost immediately and the pulse showed an instantaneous improvement. The day after another injection was made and examination showed that bacteria were no longer present in the blood. A third injection into the patient's left arm introduced 750 cubic centimetres into the circulation. The temperature fell to normal, no more bacteria were developed and the woman recovered rapidly.

For'man, Harry Buxton, English author: b. London 1842. He entered the Civil Service in 1860 and is an assistant general secretary at the General Post-office, London. Besides editing the poems of Shelley (1876–80), of Keats (1883) and other works, he has published: ‘Our Living Poets’ (1871); ‘Elizabeth Barrett Browning and Her Scarcer Books’ (1896); ‘The Books of William Morris’ (1897).

Formation, in geology, a term used of groups of rock, whether stratified or unstratified, having a similar origin or character. Thus it is usual to speak of a limestone, a sandstone, or a clay formation. The word has also been by some extended to be synonymous with system, or to denote a group of strata of the same age, as Canadian series, Carboniferous system, etc.

Formen'to, Felix, American surgeon: b. New Orleans, La., 16 March 1837; d. there, 4 June 1907. He studied at Jefferson College, Louisiana, and the University of Turin, Italy, and was a surgeon in the Franco-Sardinian army during 1859, and in the American Civil War was chief surgeon of the Louisiana Confederate hospital at Richmond, Va. At one time he was president of the American Public Health Association, later president of the Confederation of State and Provincial Boards of Health of North America, and in 1898 was appointed surgeon to the Louisiana Soldiers' Home. His publications include monographs on cremation, military surgery, alcoholics, etc.

For'mes, Karl Joseph, German-American operatic basso: b. Mülheim-on-the-Rhine, Germany, 1810; d. San Francisco, Cal., 1889. He made his first appearance at Cologne in 1841 as Sarastro in Mozart's ‘Flauto Magico.’ He quickly obtained an European reputation, and after connection in 1852–7 with the London Royal Italian Opera, came to the United States, where he was received with much approval and remained during the greater part of his life.

For'mic Acid, a monobasic organic acid having the formula CH_2O_2, or H.COOH, the final H in the last of these formulæ being the one that is replaced when the acid combines with bases to form its salts (which are known as “formates”). It is an important substance in organic chemistry, and may be obtained by the oxidation of methyl alcohol, as well as of starch, sugar, and other organic substances. The most convenient method of preparing the acid is by heating anhydrous glycerin with crystallized oxalic acid. The reaction is not a simple one, monoformin being one of the intermediate products; but the obvious part of the reaction is that the oxalic acid is converted into formic acid with liberation of carbon dioxid. Pure anhydrous formic acid is a pungent, colorless liquid, boiling at about 212° F. at ordinary atmospheric pressure (its vapor burning with a bluish flame), and freezing at about 47° F. into a white crystalline mass. Formic acid is completely resolved by strong sulphuric acid into water and carbon monoxid, $H.COOH = H_2O + CO$. It reduces Fehling's solution (q.v.), and also reduces gold and platinum to the metallic state, from their solutions. When boiled with the nitrates of silver and mercury, formic acid precipitates these metals in the form of grayish metallic powders.

Formic acid and its salts are used to a certain extent as disinfectants and preservatives. The acid takes its name from the fact that it exists, in the free state, in the bodies of red ants (*Formica rufa*), from which it may be obtained by crushing the ants and distilling the mass with water.

Formica, fôr-mī′kạ; **Formicidæ,** fôr-mĭs′ĭ-dē, the genus and family respectively which contain the typical ants. See ANT.

Formicariidæ, fôr″-mĭ-kạ rī′ĭ-dē, a family of small, tropical American birds, the so-called «ant-birds.» They are numerous in genera and species, are related to the tree-creepers and plant-cutters, and frequent forests and thickets, flying badly from the shortness of their wings and consequently feeling most at home on the ground, where they devour beetles, spiders, and insect larvæ and berries, but are not known to eat ants at all. The nests are usually made in low bushes. They wear sober colors, as a rule, and the sexes are similar.

Formigé, Jean Camille, zhoṅ kā-mēl fōr-mē-zhā, French architect: b. Bouscat, Gironde, 1845. He was a pupil of Laisné, and received from the French government a commission for a series of plans for, and restorations of, public structures; the latter including the Roman theatre at Orange, Vaucluse. He executed decorations in the Paris Hôtel de Ville, became architect of Paris streets and parks in 1885, built the Liberal Arts and Fine Arts buildings at the Paris Exposition of 1889, and the buildings of the Rumanian government at that of 1900.

Forming Machines, a term has been applied generally to the lathe, planer, shaper, and all that class of tools used by the machinist to produce the parts of machines that he manufactures. It has also been used to designate presses used for drop-forging, and for shaping metal in the cold, particularly to drawing-presses that receive a sheet of metal, grip it between two surfaces and then subject a part of it to slow pressure until it is drawn out to a cup-shape or the like, if properly done without any wrinkling. A form of rope-twisting machine is also known as a forming machine as well as a machine for forming tin cans. See FORGING AND PRESS.

Formosa, fôr-mō′sā, called by the Chinese *Taiwan*, an island lying off the coast of the Chinese province of Fû-chien, from which it is separated by a strait from 90 to 220 miles wide. Formosa, which was ceded by China to Japan in 1895, is crossed by the meridian 121° E. and the tropic of Cancer, and has a maximum length of 235 miles, while its breadth varies from 70 to 90 miles; area, 14,978 square miles. Forming one link in the volcanic chain that extends from the Aleutian Islands southward to New Guinea, it constitutes the eastern escarpment of what was once the great Malayo-Chinese continent, and is connected by a submarine plateau with the Chinese mainland. The backbone of the island, extending north and south, is formed of a range of densely wooded mountains, called by the Chinese Chu-Shan, which rise to upward of 14,000 feet, the highest known peak, Mount Morrison, being given as 14,362 feet. Eastward of this range lies a narrow strip of mountainous country, presenting to the Pacific a precipitous cliff-wall with in many places a sheer descent of from 3,000 to 7,000 feet, while a very short distance farther east the floor of the ocean sinks to a great depth at an extremely steep gradient. The western side of the range consists of a single broad alluvial plain, stretching from north to south of the island, seamed by innumerable water channels, and terminating at the coast-line in mud flats and sand-banks. Yet on this side of the island the land is rapidly encroaching upon the sea, as the consequence of the gradual elevation of the western seaboard and the deposition in and around the embouchures of the rivers of the large amount of sediment brought down by them from the mountains. This latter process is primarily due to the heavy rainfall of the northern, central, and eastern portions of the island, where the rain-clouds of the northeast monsoon, after crossing the warm Kiosiwo, or Japanese Gulf Stream, on coming in contact with the mountain barrier of the island become chilled and discharge their contents in rains of excessive violence. Apart from this heavy rainfall, the climate is not exceptional, the insular position ensuring a modification of the heat by sea-breezes. The mean of summer is 80° to 90° F.; of winter, 50° to 60°. Malarial fever is, however, prevalent in the north, and violent typhoons are very common at certain seasons.

The island is famous for the luxuriance of its vegetation; many of the hothouse plants of warm temperate climes grow wild on the mountain slopes and in the valleys, such as orchids, azaleas, lilies, rhododendrons, and convolvulus; besides which there is a profusion of ferns, tree-ferns, camphor- and teak-trees, pines, firs, wild fig-trees, liquidambars, bananas, bamboos, palms, indigo and other dye plants, fibre and paper plants, oil and soap plants, tobacco, coffee, and tapioca. «Rice paper» is prepared from the pith of a tree peculiar to Formosa. Of animal life it is noticeable that there are at least 43 species of birds peculiar to the island, that insects are scarce and that noxious wild animals are few; but that fish is plentiful near the coast. The resemblance of the animals found on the island to those on the mainland is one reason for believing there was once a land connection. However there are a number of animals on the island which appear to be of quite a different species from those found in China. This is especially true of some of the birds, mice, squirrels, and deer. The chief minerals are coal, of which there is a large supply, gold, salt, petroleum, and sulphur. Agriculture is an important industry, but the people engaged in mining are becoming more numerous.

Since the treaty of Tien-tsin, in 1858, there have been ports open for foreign commerce; those opened in accordance with the conditions of the treaty are: An-ping, Tainan, Takow, and Tam-sui. An-ping and Tam-sui have the largest amount of commerce. The principal exports are camphor, tea, rice, sugar, jute, hemp, and dye-woods. The chief imports are a coarse cloth for clothing, opium, fruits, lumber, metal goods, and manufactured tobacco. The most of the trade is with Japan. Formosa controls the camphor markets of the world. The eastern slope of the mountains is covered with the largest camphor forest yet discovered. The amount of camphor exported each year from the forests of China and Japan is about 500,000 pounds; and from

Formosa alone there is shipped between 6,000,000 and 7,000,000 pounds. Since Formosa was annexed to Japan, the Japanese government has made most successful efforts to preserve the sources of supply of camphor. When the island belonged to China the camphor-trees killed to collect the gum were not replaced and the camphor forests were being destroyed. The Japanese government insists that for every tree destroyed another one must be planted; and it is also establishing camphor plantations, so that in future the Formosa cultivated camphor will be a commodity of commerce. The price of the camphor varies because of the dangers incurred in collecting it. Savage tribes which have never been subdued inhabit the camphor forests, and they never hesitate to attack the camphor gatherers unless the latter are well armed and in bands large enough to protect each other. The Japanese government has now a large armed force of policemen, over 1,400, to protect the camphor gatherers, and the cost of protection is added to the selling price of the gum. The sale of the camphor is a government monopoly; it is not difficult to obtain a permit to gather camphor, but every pound must be sold to the Japanese government, which determines the price. Japan limits the amount to be exported, and will not buy a pound in excess of the limit. The cultivation of the tea fields is receiving attention from Japan.

The inhabitants, estimated to number about 3,000,000, consist of Chinese settlers, some Japanese, and the aborigines. Respecting the ethnological origin of these latter there exists some doubt; they seem to consist of several different tribes, mainly of Malayan and Negrito descent. The Chinese distribute them into three classes, Pepohwan, a race of civilized and sinicized agriculturists; Sekhwan, settled tribes who acknowledge Chinese rule; and Chinhwan, the untamed savages of the mountains, who wage fierce and unceasing warfare against the Chinese immigrants. The administrative headquarters were formerly at Taiwan, but on the constitution of the island into an independent province of the Chinese empire in 1887 — it had formerly been incorporated with Fû-chien on the mainland — they were transferred to Tai-pei or Bangka. The island was known to the Chinese before the Christian era, but does not seem to have seriously attracted their attention until the year 605 or 606 A.D. In the 14th century they established several colonies in Formosa, which, however, were withdrawn in the middle of the 17th century. Although Portuguese and Spanish navigators began to visit the island a century earlier, the first European people to establish themselves on it were the Dutch, who in 1624 built Fort Zealandia, near the modern Taiwan. They were, however, expelled in 1661 by a Chinese adventurer, Koxinga, who retained possession of the island for 22 years. Some years later a regular Chinese colonization of the western half of the island was carried through, the colonists coming principally from Fû-chien and Kwang-tung. Subsequently the island became notorious for the piracy of its inhabitants and the ill-treatment they inflicted upon navigators who chanced to be wrecked on their coasts. Accordingly in 1874 the Japanese invaded Formosa; but on the Chinese undertaking to check the evils complained of they withdrew. Ten years later the French, during their contest with China in Tongking, held for a time the coal districts of Kelung. The occupation by the Japanese troops did not take place without opposition from the natives and Chinese "Black Flags," but the Japanese were practically in full possession of the island before the end of 1895, and set themselves at once to the work of reorganization. Consult: Davidson, 'The Island of Formosa' (1903); Guillemard, 'Cruise of the Marchesa'; Girard de Rialle in 'Revue d'Anthropologie' (1885).

Formosa, South America, a province of Argentine, in the northeastern portion of the republic. It has an area of 42,000 square miles, and population of about 6,000.

Formo'san Deer, a small spotted deer (*Cervus taevanus*), allied to the Japanese sika (q.v.) and a favorite pet among the people of Formosa, who catch the fawns in the mountains.

Formosus, fôr-mō'sus, Pope: b. about 816; d. 896. He became cardinal bishop of Porto in 891 and succeeded Pope Stephen V. in 891. He condemned Photius, excommunicated the Emperor Lambert, Duke of Spoleto, and nominated in his place Arnoul, king of Germania. Stephen VI., his successor, had his body disinterred as that of a usurper, but under John IX., in 898, his pontificate was pronounced valid.

Forms of Address in the United States are neither so complicated nor so rigidly arranged as in countries where careful gradations of rank and title obtain. Usage, however, sanctions the forms given in the following list:

The President of the United States, governors of States ambassadors, and ministers,— "His Excellency."

The Vice-President of the United States, the heads of the executive departments, justices of supreme and superior courts, lieutenant-governors of States, and mayors,— "The Hon. ——."

Senators and representatives of the United States, or of States,— "The Hon. ——."

Ex-presidents, or ex-officials of any of the ranks above cited,— "The Hon. ——."

Archbishops, if cardinals,— "His Eminence the Cardinal Archbishop of ——."

Archbishops, if not cardinals,— "The Most Rev. the Archbishop of ——."

Bishops, in the Roman Catholic and Protestant Episcopal Churches,— "The Right Rev." or "The Right Rev. the Bishop of ——."

Bishops, in the Methodist Episcopal Church,— "The Rev. Bishop."

The designation "Esquire," once chiefly applied to lawyers, is now frequently employed in addressing gentlemen of position.

The forms of address used in foreign countries, particularly those monarchical in government, are arbitrary and elaborate.

Formula, Chemical. See CHEMISTRY.

Form'ulary, National, a volume published by a committee of the American Pharmaceutical Association containing prescriptions with directions for making a large number of widely used combinations of drugs. These combinations have been used in the treatment of disease for many years, and a more extended use of the formulary by the physician would do away with many of the proprietary remedies on the market.

Fornáris, José, hō sā' for-nä'rēs, Cuban poet: b. Bayamo, Cuba, 1826. He wrote the dramas 'The Daughter of the People,' and 'Love and Sacrifice'; and is the author of: 'The Harp of the Home'; 'Songs of the Tropics'; and other volumes of verse.

For'ney, John Weiss, American journalist: b. Lancaster, Pa., 30 Sept. 1817; d. Philadelphia 9 Dec. 1881. He was apprenticed in the office of the Lancaster *Journal* in 1833; was clerk in the National House of Representatives from 1851–5; and secretary of the United States Senate from 1861 to 1868. He was connected with several papers in Philadelphia and Washington. Author: 'What I Saw in Texas' (1872); 'Anecdotes of Public Men' (1873); 'Forty Years of American Journalism' (1877).

Fornix. See Brain.

For'rest, Edwin, American actor: b. Philadelphia 9 March 1806; d. there 12 Dec. 1872. In 1820 he made his first appearance in public in the part of Douglas in Home's tragedy of that name, and coming before the New York public in 1826 in the character of Othello, at once gained popularity. In 1836 he crossed the Atlantic and entered on a season at Drury Lane Theatre, London. In the parts of Macbeth, Lear, and Othello he achieved distinguished success, and acquired the friendship of Macready, Kemble, and others. He again visited England in 1845, and on this occasion quarreled bitterly and causelessly with Macready, whom he accused of trying to damage his reputation from professional jealousy. This quarrel crossed the Atlantic, and when Macready was playing in the Astor Place Theatre, New York, in 1849, the partisans of either actor stirred up a riot that was accompanied by serious loss of life. Between 1853 and 1860 he retired from professional life, but when he returned to the New York stage he filled the role of Hamlet with all his former acceptance. Latterly he suffered considerably from illness, and his last engagement was in 1871. He was a man of fine presence, well equipped for his profession, naturally frank and engaging. He left a large fortune. See Rees, 'The Life of Edwin Forrest' (1874); Alger, 'Life of Edwin Forrest' (1877); Barrett, 'Edwin Forrest' (1882).

Forrest, Sir **John,** Australian explorer and politician: b. Western Australia 22 Aug. 1847. He entered the survey department of Western Australia in 1865, and in 1874 was at the head of a party which explored the interior from Champion Bay on the west to the overland telegraph line connecting Adelaide on the south with Port Darwin on the north coast. After holding various government posts he was returned unopposed in 1890 to the first Western Australia Legislative Assembly for Bunbury, and was premier and treasurer 1890–1901. He was postmaster-general of Australia 1900–1; minister for defence 1901–3; minister for home affairs 1903–4; treasurer since July 1905; and since 1901 has represented Swan in Parliament. His publications are: 'Explorations in Australia' (1876); and 'Notes on Western Australia' (1884–7).

Forrest, Nathan Bedford, American soldier: b. Bedford County, Tenn., 13 July 1821; d. Memphis, Tenn., 29 Oct. 1877. Moving with his father to Marshall County, Miss., he was in a short while, by the death of his father, left to support his mother and family with a small hill farm. He undertook this work with devotion and energy, and, getting into business in Memphis, became able to purchase a large plantation, and was at the outbreak of the Civil War one of the wealthiest planters in Tennessee. Circumstances had forced him to neglect his own education, though he provided liberally for that of his brothers and sisters. On 14 June 1861 he entered the Confederate service as a private in White's mounted rifles, but soon obtained authority to raise a regiment, which he did, purchasing at his own private expense its equipment in Louisville, Ky. These supplies he carried to Memphis, displaying remarkable ingenuity and daring both in eluding the Federal authorities and in defeating a body of their troops with 75 Kentucky Confederates who had come to his assistance. Joining his regiment to the force defending Fort Donelson in February 1862, he was distinguished in the fighting at that point, and, when his superiors had determined upon surrender, led his men through a sheet of icy water past the Federal lines and escaped. Joining Albert Sidney Johnston (q.v.), he was distinguished at Shiloh, where he received a painful wound, which, however, did not long keep him from the field; and by a series of successful movements in Middle Tennessee, then occupied by the Federals, he rapidly rose to great distinction as a cavalry leader, and on 21 July 1862 was promoted brigadier-general. During Bragg's Kentucky campaign he performed great services both on the advance and retreat. Among his most famous exploits in Middle Tennessee was the expedition in which, with less than 1,000 men, he captured McMinville, and, surprising a garrison of 2,000 Federals at Murfreesboro, captured all the survivors of the fight, including Gen. Crittenden. On 8 May 1863 he captured a raiding force of Federals under Gen. Streight, near Rome, Ga., the Federal force being so much larger than his own that he pressed into service all the citizens in reach in order to form an adequate guard.

After highly distinguished service at the battle of Chickamauga, he was so dissatisfied with the failure to reap the full fruits of that great victory that he tendered his resignation. This was not accepted, but, instead, he was promoted major-general and assigned to the command of all the cavalry in West Tennessee and North Mississippi. Entering West Tennessee with a small force, he was reinforced by several thousand hardy volunteers, who, with his veteran troops, were soon welded into an invincible body known as «Forrest's cavalry.» In February 1864 he routed Gen. S. Smith at Okatona, Miss.; then swept northward through Tennessee to the Ohio River, capturing Fort Pillow, Union City, and other posts, with their garrisons. In June 1864, with a much smaller force than the enemy, he defeated Gen. Sturgis at Brice's Cross Roads (or Tishamingo Creek), near Guntown, in North Mississippi, capturing all his trains and a third of his men. Gen. A. J. Smith then advanced against him, but after fighting a desperate battle at Harrisburg, near Tupelo, in Mississippi, retreated. Receiving reinforcements from Memphis, Smith advanced again, but Forrest foiled him by making a 60-hour ride to Memphis with half of his force, and by his daring entry into that city compelled Smith's rapid retreat. Then Forrest made havoc with Federal transportation, capturing garrisons and depots in Tennessee, and crowning his exploits by the capture and destruction of $6,000,000 worth of Federal supplies and a gunboat fleet at Johnsonville. Sherman wrote of this as a feat of arms which excited his admiration. Upon Hood's advance into Tennessee, Forrest joined him at Florence and performed important services. As commander of the rear guard of the Confederate army during the retreat from Nashville, his display of heroic qualities and brilliant leadership increased his already great fame. In February 1865 he was promoted lieutenant-general, and to him was assigned the duty of guarding the Confederate frontier from Decatur, Ala., to the Mississippi River. The surrender of the remnant of his command took place on 9 May 1865. During his career he had captured 31,000 prisoners. After the War he returned to civil life.

Joseph T. Derry,
Author of 'The Story of the Confederate States.'

Forrester, Fanny, pen-name of Emily Chubbuck Judson (q.v.)

Forsh'ey, Caleb Goldsmith, American engineer: b. Somerset County, Pa., 18 July 1812; d. Carrollton, La., 25 July 1881. He was educated at Kenyon College, Ohio, and the United States Military Academy, was professor of mathematics and civil engineering in Jefferson College, Mississippi, 1836–8, and from 1851–3 was engineer-in-charge of the governmental survey of the Mississippi delta. Though actively opposed to the secession movement, he became lieutenant-colonel of Confederate engineers upon the withdrawal of Texas from the Union. He collaborated in 'The Physics of the Mississippi River' (1861).

Forskål, fôr'skâl, **Peter,** Swedish botanist: b. Helsingfors 11 Jan. 1732; d. Djerim, Arabia, 11 July 1763. In 1761 he was selected by Frederick V. of Denmark to join the scientific expedition to Arabia, to take charge of the department of natural history. He set out on this expedition with Niebuhr, Von Haven, and Kramer, and collected plants in the environs of Marseilles, of which he published a 'Flora' at Malta. Niebuhr collected Forskal's papers, accompanied them with remarks, and published them under the titles: 'Descriptiones Animalium, Avium, Amphibiorum, Piscium, Insectorum, quæ in Itinere Orientali observavit P. Forskal' (1775); 'Flora Ægyptiaco-Arabica, etc.'; 'Icones Rerum Naturalium, quas in Itinere Orientali depingi curavit Forskal' (1776).

Forster, Johann Reinhold, yō'hän rīn'hōlt fôr'stĕr, German naturalist: b. Dirschau, Prussia, 22 Oct. 1729; d. Halle 9 Dec. 1798. In 1753 he became pastor at Nassenhuben, but devoted most of his time to the study of mathematics, natural philosophy, natural history, and geography. In 1772 he received the offer of naturalist to Capt. Cook's second expedition to the South Seas. In association with his son, he published a work on the botany of the expedition, and 'Observations Made During a Voyage Round the World.' He wrote also: 'Introduction to Mineralogy'; 'Flora of South America'; 'Zoology of India'; etc.

Forster, fôr'stĕr, **John,** English historical writer: b. Newcastle-on-Tyne, England, 2 April 1812; d. London 2 Feb. 1876. He was educated for the law; held one or two public offices, and finally engaged in literature and journalism and was editor of the London 'Examiner' for nine years. He is best known for his 'Life of Charles Dickens' (1871–4). He also wrote: 'Statesmen of the Commonwealth of England' (1831–4); 'Life of Oliver Goldsmith' (1848); 'Walter Savage Landor' (1869;) etc.

Forster, fôr'stĕr, **William Edward,** English statesman: b. Bradpole, Dorsetshire, 11 July 1818; d. London 5 April 1886. He was educated at the Friends' School at Tottenham, and was active in the woolen trade in Bradford. In 1850 he married the eldest daughter of Dr. Arnold of Rugby. In 1865 he became under-secretary for the colonies; in 1868 was appointed vice-president of the council on education and a privy councilor; and in 1870 accepted a seat in Gladstone's cabinet, and carried through Parliament the Elementary Education Bill (1870) and the Ballot Bill (1872). In 1880 he accepted the post of chief secretary for Ireland at a time when that country was distracted by political and agrarian tumults. To mitigate the severity of the numerous evictions he introduced a Compensation for Disturbance Bill (1880), which was rejected by the House of Lords. The following year he introduced a Land Bill and a Coercion Bill, both of which were passed, and in order to check the growing power of the Land League he declared that organization illegal, and imprisoned Parnell and other members of his party. In April 1882 the government resolved to release the Parnellites and adopt a more conciliatory policy, whereupon he resigned his office. Subsequently he was often found acting in opposition to the government, chiefly in reference to foreign affairs, and he was also opposed to a separate Irish parliament in Dublin. His opinion on the latter question carried great weight because of his well-known sympathy for Ireland, his abilities as a statesman, his experience in affairs, and his unquestioned honesty. Consult 'Life of Forster,' by Wemyss Reid (1888).

Forsyth, George Alexander, American military officer: b. Muncy, Pa., 7 Nov. 1837. He served with distinction in the Civil War; was brevetted colonel for gallant services at Five Forks, and brigadier-general in 1868 for his action in an engagement with hostile Indians. He was a member of the board of officers to inspect the armies of Europe and Asia in 1875–6, and on staff and frontier service till 1890, when he was retired on reaching the age limit. He has published: 'Thrilling Days in Army Life' (1900); 'The Story of the Soldier' (1900).

Forsyth, John, American politician: b. Fredericksburg, Va., 1780; d. Washington 21 Oct. 1841. He was graduated at Princeton College in 1799, and was admitted to the bar in Augusta, Ga., in 1802. He was elected attorney-general of the State in 1808, representative in Congress in 1812, and United States senator in 1818. In 1820 he was sent to Spain as resident minister, where he conducted the negotiations concerning the ratification and execution of the treaty by which Florida was ceded to the United States. In 1823 he was again chosen to the House of Representatives, and was one of the main supporters in Congress of Gov. Troup of Georgia in his contest with the national government concerning the removal of the Creek and Cherokee Indians. He became governor of Georgia in 1827, and in 1829 was again returned to the United States Senate. He opposed the South Carolina movement of nullification from its beginning, and voted in favor of Mr. Clay's compromise act of 1833. In the debate in 1834 on the removal of the deposits from the United States bank, he supported the President, who afterward appointed him secretary of state, an office which he retained till the retirement of President Van Buren in 1841.

Fort Adams, R. I., a United States military post established 1841, at Brenton's Point, R. I., near Newport. There was a garrison here during the Revolution. See MILITARY POSTS, U. S.

Fort Anderson. See WILMINGTON, CAPTURE OF.

Fort Ann, N. Y., a village and former fort in Washington County; on Wood Creek and Champlain Canal. The first fort was built here in 1709, rebuilt in 1757. The British captured the fort in 1777, and partially destroyed it. Pop. of village (1910) 436.

Fort Blakely, Siege and Capture of. Fort Blakely was erected by the Confederates as one of the inland defenses of Mobile, on the east bank of the Apalachee River, and opposite its confluence with the Tensas, about 10 miles northeast of the city. It was on high ground and nearly 3 miles in extent, with 9 well-built redoubts or lunettes armed with about 40 guns. In front was a deep and broad ditch, also an abatis. The garrison consisted of Gen. F. M. Cockrell's division of veteran troops and Thomas' division of Alabama Reserves, in all about 3,500 men, under command of Gen. St. John Lidell. On 20 March 1865 Gen. F. Steele set out from Pensacola and, by a circuitous march of 100 miles, reached the rear of the fort 1 April and invested it on the 2d with Garrard's division of the 16th corps, Veatch's and Andrews' divisions of the 13th, and Hawkins' division of colored troops, in all 13,000 men. Gradual approaches were made, accompanied by heavy and constant skirmishing, and by the 8th Steele had portions of his advanced lines within 450 to 600 yards of the works and 28 guns in position. A general assault was made about 6 P.M. of the 9th; there was a severe struggle in overcoming the obstructions in front of the work; but they were carried and the main works taken by assault, with 3,432 prisoners, 40 guns, and 16 battle-flags. The Union loss was 113 killed, 516 wounded. The Confederate loss is not known. The assault on Blakely was the last considerable engagement of the War, and was followed by the fall of Mobile and surrounding forts and by the surrender of the Confederate navy in the harbor. Consult: 'Official Records,' Vol. LI.; Andrew, 'Siege of Mobile.'

E. A. CARMAN.

Fort Bliss, Tex., a former United States military post on the Rio Grande, 3 miles from El Paso, established 1868. For the present post of this name at El Paso, see MILITARY POSTS, U. S.

Fort Bowyer, bō'yėr, Ala. (present site of Fort Morgan), a former United States fort at the entrance of Mobile Bay. It was built in April 1813 and was surrendered to the British 8 Feb. 1815.

Fort Can'by, Wash., a United States military post formerly called Fort Cape Disappointment, established on the north shore of the mouth of the Columbia River in 1864. See MILITARY POSTS, U. S.

Fort Caswell, kaz'well, N. C., a United States military post, established 1825, on Oak Island, Cape Fear River. See MILITARY POSTS, U. S.

Fort Chippewy'an, or **Chipeway'an,** Canada, a trading station on Lake Athabasca, owned by the Hudson Bay Company.

Fort Clark, Tex. See MILITARY POSTS, U. S.

Fort Clinton, N. Y., a fort built on the Hudson River, near West Point, in 1777. It was soon after abandoned.

Fort Collins, Colo., a city and county-seat of Larimer County, on the Colorado & S. R.R.; 74 miles north of Denver. The State Agricultural College is here. Pop. (1910) 8,210.

Fort Columbus, N. Y., a United States military post established on Governor's Island, New York harbor, in 1806. It is the headquarters of the Department of the East and has Castle William, military prisons. See FORTIFICATIONS; MILITARY POSTS, U. S.; MILITARY PRISONS, U. S.

Fort D. A. Russell, Wyo. See MILITARY POSTS, U. S.

Fort Darling (Drewry's Bluff), Attack on, 7 May 1862. President Lincoln, then at Fort Monroe, received a dispatch from Gen. McClellan that his cavalry had made a reconnaissance to Jamestown, on James River, that a Confederate battery at that point had been abandoned, and if it were possible for the Galena and other gunboats to move up James River, it would aid him in his movement up the Peninsula on Richmond. The President directed Flag-officer Goldsborough, if he deemed it proper, to send the Galena and two gunboats. On the morning of 8 May Capt. John Rodgers, with the Galena, Aroostook, and Port Royal, went up the river and engaged two batteries of 10 guns each, one of which he silenced; the other he passed, two Confederate gunboats retiring up the river as he approached. Rodgers worked his way up the river, meeting with no serious opposition until he arrived at Fort Darling, on Drewry's Bluff, eight miles below Richmond, a strong position on the right bank of the river, about 200 feet above it, and mounting five heavy guns, manned by the crews of the destroyed Merrimac and other ships at Norfolk, under command of Captain Farrand, C. S. Navy. The guns were mounted in such position as to give a close and plunging fire upon an advancing vessel. At the foot of the bluff the river had been obstructed by piles and sunken vessels secured by chains, and the shore was lined with rifle-pits, sheltering sharpshooters. Rodgers was now joined by the Monitor and Naugatuck, and on the morning of the 15th ran up and opened fire, the Galena leading and anchoring within 600 yards of the fort. The Monitor could not bring her guns to bear, and the action was principally confined to the Galena, which, after a contest of nearly three and a half hours, withdrew, having been struck 28 times, and losing 24 men killed and wounded. Two of the Confederate guns were dismounted, and Farrand reported a loss of 7 men killed and 8 wounded. Two or three days later, recognizing the fact that the co-operation of the army was needed to carry the position, Goldsborough proposed to McClellan a joint attack, but McClellan preferred waiting until he got his army across the Chickahominy. The Confederates strengthened the position and it remained in their possession until the close of the war, an obstacle to the advance of the gunboats up the James to Richmond, and also to the operation of the army investing Richmond and Petersburg. Consult: 'Naval War Records,' Vol. VII., Allan, 'Army of Northern Virginia.'

E. A. Carman.

Fort Dearborn, a fort built in 1804 by the United States government on the south bank of the Chicago River near its mouth and on the site of the present city of Chicago. At that time the river took a sharp turn to the south just east of the fort and flowed into the lake over a heavy sandbar, which was not capable of being crossed by anything larger than a small boat, and all large vessels bringing supplies to the garrison were compelled to anchor outside and land their passengers and cargoes in small boats. The site of the fort was on a reservation of six square miles which by Wayne's treaty with the Indians, made at Greenville in 1795, had been set aside from the United States. It was named in honor of General Henry Dearborn (q. v.), then Secretary of War.

The fort consisted of a stockade with two block-houses, built in the fashion of all military posts of that period which were situated on the frontier in the vicinity of Indian tribes. The quarters of the garrison were inclosed within the stockade and the first garrison consisted of one company of infantry (of the First regiment).

The growth of the settlement at Fort Dearborn was not rapid until after the War of 1812, owing to the numerous depredations of the Indians upon the white settlers and to the fact that it was so far in the wilderness, being reached from Detroit by a trail through the woods and from Mackinac by lake schooners, generally one in the spring and one in the fall.

Fort Dearborn owes its notoriety, however, to the massacre which occurred near there on 15 Aug. 1812. The second war with Great Britain had broken out and in the beginning in the northwest all the advantage lay with the British forces and their Indian allies. Mackinac had been captured, thus securing control of the upper lakes to the British, and the American government, apprehensive that a post among the Indians, so far from the frontiers, could not be successfully maintained, thought best to abandon it. Accordingly, General William Hull, in command at Detroit, issued orders to Captain Nathan Heald, in command of the garrison, to evacuate the fort and that the surplus stores should be divided among the Indians. These orders were executed and on 15 August the garrison and a body of supposedly friendly Miami Indians, escorting a number of women and children, marched out of the fort and set out for Detroit by a road which wound along the lake shore. At a point among the sandhills about two miles from the fort an ambushed band of about 500 Potawatomie Indian savages, in conjunction with the party of Miami who accompanied the troops, attacked the little expedition and the whole body of whites were either captured or killed. Two of the women and 12 children were butchered during the fight, and a number of the wounded men were killed afterward, but some were fortunate enough to be ransomed later. The Indians then sacked the fort and burned it.

In 1816 after peace was concluded the fort was rebuilt under Captain Bradley and its outlines were much extended, under the protection of its larger garrison a small village springing up. In 1823 the fort was again evacuated, but continued to be occupied from 1828 to 1837 when, the Indians having left the country, it was again abandoned, and finally, in 1856, destroyed.

Fort de France, för dé fräñs, or *Fort Royal*, för-rwä-yal, Martinique, French West Indies, a town, seaport and capital of this island of the Lesser Antilles, which, except Guadeloupe, is the largest in the Caribbean chain. It is situated in the southwestern part of the island and on the north side of a deep and well-sheltered bay protected by a fort. The city is important as it is the military and naval headquarters and rendezvous in the French Antilles, the Governor's residence, and the terminus of the French transatlantic steamers, and the West Indian cable system. The principal buildings are the parish church, government offices, the barracks, arsenal, prison, and hospital. Fort Royal is the residence of the French Governor. There is a law school in the city. In the public gardens is a statue of the French Empress, Josephine, who was born in Martinique. In 1839 Fort de France was partially destroyed by an earthquake, and in 1890 fire nearly consumed the entire city. The eruption of Mont Pelée (q. v.), in May 1902, did no material damage to the city, but it became the distributing centre for the supplies sent to the island from outside sources.

Fort De L'Écluse, för de lä'kluz', a fortress in the Department of Ain, France, on the Rhone River, west of Geneva, standing upon a crag 1,385 feet high, at the foot of Mont Credo, which commands the passage of the Rhone River from Switzerland through the defile of the Écluse. It was erected by the Dukes of Savoy, and during the 16th century was repeatedly the object of attacks by the Swiss armies, and was several times destroyed. During the reign of Louis XIV. it was rebuilt by Vauban at the King's command, but in 1815 was captured and demolished by the Austrians. Again coming into French possession it was completely restored and since then the fortifications have been remodelled and much strengthened.

Fort Dodge, Iowa, a city and county-seat of Webster County; on the Des Moines River, and on the Illinois C., the Chicago G. W., and the Minneapolis & St. L. R.R.'s; 135 miles east of Sioux City, 200 miles west of Dubuque, 85 miles north of Des Moines, and 200 miles south of Minneapolis.

Industries.— The city has many natural advantages, being an important railroad centre (the railroad shops employing, on an average, 1,200 men); in the vicinity are large deposits of coal, gypsum, and potter's and brick clay; and it is the jobbing centre for the surrounding territory. Among the industries are a shoe factory, oat-meal mill, several plaster mills, brick plants, pottery works, boiler works, and foundries.

Public Works, Institutions, Buildings, Etc.— The educational facilities comprise high and public schools, parochial schools, Tobin College, and Elmwood school. Nearly all religious denominations are represented in the city. Among the notable public buildings are the County Court House, Government Building, and Public Library. There are five banks in the city, with a combined capitalization of $475,000.

History, Government, and Population.— Fort Dodge was first settled in 1854 by Major William Williams, became a borough in March 1854, and was incorporated as a city in 1869. The affairs of the city are administered under the commission form of government, it being one of the first cities in the State to adopt the new method. The city owns and operates the water-works. The predominating foreign nationalities represented in the population are Scandinavians, Germans, and Irish-Americans. Pop. (1910) 15,543.

C. F. DUNCOMBE,
Editor of 'The Chronicle.'

Fort Donelson, a fort erected in 1861 by the Confederates in Stewart County, northwestern Tennessee, just south of the boundary line between Kentucky and Tennessee, on the left bank of the Cumberland River, and about 63 miles northwest of Nashville, and 12 miles from Fort Henry. It was on a hill 120 feet above the level of the river and, having a line of rifle pits 2½ miles in extent to defend the land approach, and three heavy batteries commanding the river, it was considered one of the best fortified posts along the Confederate line of defense in the Mississippi valley. Here, on 13–16 Feb. 1862, an important battle was fought between General Grant in command of the Union forces, and General Buckner in command of the Confederates, finally resulting in the surrender of the fort by Buckner, together with 57 guns, 14,500 men, and immense quantities of provisions and munitions of war. See FORT HENRY AND FORT DONELSON.

Fort Douglas, a United States military post in Utah, on the Union Pacific R.R., three miles east of Salt Lake City and 37 miles from Ogden. It was established in 1862, occupies a reservation of over 9,000 acres at the base of the Wahsatch Mountains, and has quarters for about 500 soldiers.

Fort Dupont, a United States military post in New Castle County, Delaware, opposite Pea Patch Island. It occupies a reservation of about 175 acres and has quarters for two companies of infantry.

Fort Du Quesne, a colonial fort in Pennsylvania erected at the confluence of the Allegheny and Monongahela rivers and upon the site of the present city of Pittsburg (q. v.). It was begun in February 1754 by a force of Virginians under Captain William Trent, and Ensign Ward, who had been sent forward by Governor Dinwiddie, of Virginia, to erect a fortification of sufficient size to be a warning to the French against further intrusion on English territory. On 17 April, before the work had been completed, the Virginians were attacked by a force of 700 French and Indians and were compelled to leave the fort, which was then enlarged and completed by the French, who named it Du Quesne. Near the fort, on 9 July 1755, took place the terrible defeat of the British General Braddock (q. v.), who was ambushed there by a detachment of French and Indians, while on his way to retake the fort from the French. The fort and surrounding territory remained in the possession of the French until 25 Nov. 1758, when General Forbes, leaving Philadelphia early in July in command of an army of 10,000 British and Colonial troops, with a few Indian allies, met Colonel George Washington (q. v.), and together captured it, not, however, till the French had fired it and fled. It was then, at Washington's suggestion, renamed «Pittsburgh,» in honor of the British Prime Minister, William Pitt.

The fort was occupied for the winter by a small garrison, and in 1759 General Stanwix built Fort Pitt, which was the scene of many engagements during the Indian wars, and the French and Indian War. During the period of Pontiac's Conspiracy in 1763 the Indians besieged the fort, then under command of Captain Ecuyer, from 22 June to 6 August, but were twice defeated by the troops from the fort, and were finally driven off by a force of 500 British regulars under Colonel Henry Bouquet, who had been sent by General Amherst. Bouquet, a short time afterward, built a brick blockhouse not far from the fort, and this «Old Blockhouse,» which is still standing, is the only remnant of the extensive fortifications erected by the British during their occupancy of the vicinity till the outbreak of the American Revolution. This remnant is now owned and is being preserved by the Daughters of the American Revolution. See COLONIAL WARS IN AMERICA. *1755-63, Seven Years War; 1758, Louisburg . . . Du Quesne; 1763-4, Pontiac's War.*

Fort Edward, N. Y., colonial, on the upper Hudson at its great bend, where stands the present village of Fort Edward; known as the Great Carrying Place during the 17th and 18th centuries (that is, to Lake George and Lake Champlain), and an obvious advanced post for Canadian wars. Francis Nicholson built a stockade there for that purpose in 1709; it rotted away in disuse, but in 1755, at the opening of the French and Indian War, Phineas Lyman began another called by his name. It was finished by Col. Eyre under Sir William Johnson, who after the battle of Lake George (q. v.) renamed it Fort Edward, after the Duke of York, grandson of George II. In 1757 it was raided from Canada and 11 soldiers killed. Later, the survivors of the massacre of Fort William Henry (q. v.) were sent here by Montcalm, and shortly afterward several thousand militia flocked thither to the rescue, but had to be sent home as arriving too late. In March 1758 an expedition from there under Major Robert Rogers was nearly destroyed by the Indians. During this period Fort Edward was known to the French as «Fort Lidius» or «Lydius.» Jane McCrea (q. v.) was living in a little settlement near the fort, when she started on her ill-fated journey 27 July 1777 to meet her lover in Burgoyne's camp. After her death she was buried near the «black house» at Fort Edward Centre. Her remains were removed in 1823 or '24 to the old Fort Edward Cemetery: in 1852 her remains were again exhumed and buried in the Union Cemetery between Fort Edward and Sandy Hill. The Jane McCrea Chapter, D. A. R., has erected a marker at Fort Edward near the spot where she was killed. In the Revolution the old fort was successively the headquarters of Schuyler, Burgoyne, and Stark. Consult Parkman, 'Montcalm and Wolfe' (1884), 'Fort Edward in 1779–80,' 'Historical Magazine' 2d series Vol. II. (187). Fort Edward village is located on the Delaware and Hudson Railroad, Champlain Canal, and Hudson Valley Railway. Here through a system of locks the Glens Falls Feeder empties into the Champlain Canal. The manufacture of pulp and paper constitutes the principal industry of the village, and here are large mills of the International Paper Co. Trust. It is noted as the home of the Fort Edward Collegiate Institute, has a good union school system, a flourishing national bank, and five churches. Fort Edward possesses many points of interest to the antiquarian and historian on account of its intimate connection with the events of the French and Indian, and the Revolutionary Wars. Pop. (1910) 3,762.

JAMES A. HOLDEN.

Fort Erie, Canada, a post village in Welland County, Ontario, on Lake Erie, at the head of the Niagara River, opposite Buffalo, N. Y., with which it is connected by a railroad bridge. Three railways enter the town which is a port of entry and has an American consulate. Pop. about 1,100. The present town stands upon the site of old Fort Erie which was the scene of considerable fighting during the War of 1812. On 28 May 1813 the British forces abandoned the fort and partially demolished it and during the next few months, with the varying fortunes of war, it was held alternately by the American and British forces. Early in July 1814 Major-General Jacob Brown (q. v.) with 5,000 troops backed by 4,000 New York militia, which had been ordered out and authorized for the war, invaded Upper Canada from Buffalo and one of his first objects of attack was Fort Erie which surrendered to him on 3 July. Two days later at Chippewa he successfully attacked General Riall with a loss of 511 men killed and wounded. After the bloody battle of Lundy's Lane (q. v.) on 25 July, fought between the American Generals Brown and Winfield Scott and the Canadian General Sir Gordon Drummond (q. v.), the American forces, numbering about 2,000 men, under command of General Ripley (both Brown and Scott having been wounded), were forced to return to the fort, having suffered a loss of 743 men as against a British loss of 878. The American forces were shortly afterward (7–14 August) unsuccessfully attacked by Drummond, who, after an almost constant bombardment during the seven days, retired with a loss of 500 men. Brown was, however, blockaded within the walls of the fort until September. The fort remained in possession of the Americans till 5 November, when, upon retiring from Canada, they blew up the fortifications and they were never subsequently rebuilt. See UNITED STATES — THE WAR OF 1812.

Fort Ethan Allen, a United States military post located near Essex Junction, Vt., about five miles east of Burlington, occupying a reservation of 761 acres. It was established in March, 1893, has accommodations for about 800 troops, and was designed to form a link in the chain of military posts along the northern frontier of the United States.

Fort Fisher, in North Carolina, erected by the Confederates on the peninsula between Cape Fear River and the Atlantic to defend the entrance to the port of Wilmington, was one of the most formidable earthworks on the Atlantic coast and was built to withstand the heaviest artillery fire. Its parapets were 25 feet thick, with an average height of 20 feet, and mounted 44 heavy guns. At the close of 1864, when it was determined by the United States forces to reduce it and close the port of Wilmington to blockade-runners, it had a garrison of 1,400 men, under command of Col. William Lamb. The combined naval and army expedition sent against it was under command of Admiral D. D. Porter and General B. F. Butler. Porter's fleet of about 150 vessels, the largest that had ever sailed under the Union flag, left Hampton Roads 13 Dec. 1864 and arrived in sight of the fort on the 20th. As a preliminary to the attack the old steamer Louisiana was loaded with 215 tons of powder which was to be exploded under the walls of the fort, with the expectation that the explosion would dismount the guns, level the works, and demoralize the garrison, thus allowing the troops to land and easily take the work. At 1:40 A. M. of the 24th, without notifying Butler of the fact, when the Louisiana was within 300 yards of the beach and 400 yards of the fort, the powder was exploded, but did no damage, scarcely disturbing the slumbers of the garrison. At daylight the fleet ran in, and at 11 o'clock opened a furious fire, which was continued several hours, doing no material damage, and was responded to with spirit and effect. On the 25th the bombardment was renewed and under cover of it Butler landed 3,000 men two miles above the fort, and was assured by Porter that the navy had so completely silenced the work that all he had to do was to march his troops into it. But Butler and Weitzel, who was in immediate command of the troops, after a careful reconnaissance found the fort uninjured, deemed it unadvisable to attack it, re-embarked the men, and returned to James River to assist in the siege of Petersburg. Porter's fleet lost 83 men killed and wounded. The Confederates had 58 killed and wounded. The failure to take the fort produced great disappointment; it is now generally conceded that Butler and Weitzel acted wisely in not making the attempt. A second expedition against the fort sailed 12 Jan. 1865, and on the 13th 8,000 men were landed under Gen. A. H. Terry, who had been designated to command the land forces, which, as before, were under the immediate command of Gen. Weitzel. At 3.30 P.M. the fleet stood in and began a furious bombardment, which was continued next day, causing a loss to the garrison of 200 men, and silencing many of the guns. A combined naval and land attack was planned for the 15th, and 1,600 sailors and 400 marines were landed to co-operate with the army. The fleet opened fire at 9 A.M. and continued it until 3 P.M., when 50 steam-whistles from the fleet gave the signal for the land assault. The naval column, armed with cutlasses and pistols, charged the right flank or sea-face of the work, reached its foot, and those in advance began to climb the parapet, but the Confederates mounted on it repulsed them, and the entire body retreated in disorder with a loss of 82 killed and 269 wounded. The army was more successful; advancing on the left flank or land-face of the work, it forced a lodgment, and after a hard struggle, which was continued far into the night, carried the entire work, capturing, as reported by Gen. Terry, about 2,000 men, with a loss of over 900. The Confederate defense of the fort was one of the most gallant of the War, and cost them about 500 killed and wounded. The Union loss, army and navy, was 266 killed, 1,018 wounded, and 57 missing. The fall of Fort Fisher closed the port of Wilmington, and was soon followed by the fall of that city. Consult: 'Official Records,' Vol. XLII.; 'Naval War Records,' Vol. XI.; Ammen, 'The Atlantic Coast'; Maclay, 'History of the Navy,' Vol. II.; The Century Company's 'Battles and Leaders of the Civil War,' Vol. IV.

E. A. CARMAN.

Fort Gaines and **Fort Morgan.** Fort Gaines was a walled work on Dauphine Island, at the western entrance of Mobile Bay, and with Fort Morgan, a much larger work, on Mobile Point, nearly four miles distant, at the eastern entrance, was seized by the governor of Alabama 5 Jan. 1861. Both forts remained in Confederate possession until August 1864, at which time Fort Gaines had 30 guns. Fort Morgan was armed with over 40 guns, and had a mortar battery in front of seven heavy guns. Admiral Farragut attacked and passed both works when he ran into Mobile Bay, 5 Aug. 1864, and virtually destroyed the Confederate squadron. Gen. Gordon Granger landed troops on Dauphine Island on the 4th and began to invest Fort Gaines; on the 6th Farragut shelled it, and on the 7th the fort and its garrison of 818 officers and men surrendered. Fort Morgan held on longer, but Granger transferred his troops from Dauphine Island to the rear of the fort, invested it, got 34 guns in position to bear on it, and on the morning of the 22d, in co-operation with Farragut's fleet, opened his guns upon it, and kept up a continuous fire until the morning of the 23d, when the fort surrendered to Farragut.

E. A. CARMAN.

Fort Garry, Canada. See WINNIPEG.

Fort George, Canada, a former fort on the Canadian side of the Niagara River. On 27 May 1813 it was captured by the American forces under Col. Winfield Scott. On 10 Dec. 1813 the fort was evacuated by Gen. McClure. See FORT GEORGE, BATTLE OF.

Fort George, Battle of, 27 May 1813, in the War of 1812. The fort was near the mouth of the Niagara River, on the Canada side, nearly opposite Fort Niagara, and was garrisoned by about a thousand British regulars and several hundred militia under Gen. Vincent. The American force of some 4,000 undertook to take it in rear and capture the garrison; the nominal commander was Morgan Lewis, the real one Winfield Scott. The forces were landed from the fleet, nominal commander Chauncey, real one Oliver Hazard Perry, and a joint attack was made. The fleet enfiladed the beach; Scott advanced along the shore, and made a flanking movement. Vincent evacuated the fort, spiked the guns, and slowly retreated, parallel to the river, beyond Queenston Mt., losing 51 killed and 305 wounded and missing, from his regulars, while most of the militia were captured. American loss, 40 killed, 120 wounded. The other forts on the river were soon abandoned by the British.

Fort Getty, S. C. See MILITARY POSTS, U. S.

Fort Grant, Ariz., a United States military post and reservation at the foot of Mount Graham, established in 1863 by the California volunteers. See MILITARY POSTS, U. S.

Fort Greble, R. I. See MILITARY POSTS, U. S.

Fort Griswold, Conn. See FORT GRISWOLD, MASSACRE OF; MILITARY POSTS, U. S.

Fort Griswold, griz'wōld, **Massacre of,** 6 Sept. 1781. Hearing of Washington's southern march, Sir Henry Clinton, as the only available diversion, sent an expedition against New London, Conn., where a quantity of stores were collected, with slight defense from Fort Trumbull on the New London side and Fort Griswold on the Groton side of the Thames, and which was a nest of privateers that had greatly annoyed the British. Benedict Arnold was selected to head it, as a Connecticut man; an ugly method of making him seal his new allegiance. On taking possession of Fort Trumbull, it became evident that the American shipping would escape unless Fort Griswold were captured also; it was reported unfinished and occupied only by 20 or 30 men, and he ordered an attack on it. Shortly seeing that it was stronger than he supposed, and garrisoned by those who had escaped from Fort Trumbull, and that the ships were escaping up the river, he countermanded the order, but too late. The British detachment of 600 regulars had assailed the fort, where 157 militia had gathered; and after 40 minutes' assault, with the loss of 192 men, the British carried it, and despite the appeals for quarter, massacred nearly the whole garrison. Col. Ledyard, the commander, and 70 others were killed, 60 wounded, 35 mortally, and only 26 escaped unhurt. The British officers, however, did their best to stop the slaughter, and the atrocious story formerly told of the murder of the colonel is fiction. The massacre of garrisons *in terrorem,* to teach them not to defend untenable places, was justified by the European rules of war at the time, but had not been practised in America. Even American officers, however, spoke of it at the time as a regrettable but almost inevitable incident of war.

Fort Hamilton, N. Y., a United States military post at the Narrows, New York Bay, established in 1831. See MILITARY POSTS, U. S.

Fort Hancock, N. J. See MILITARY POSTS, U. S.

Fort Harrison, Battle of (including Chaffin's Farm, Fort Gilmer, and New Market Heights). In the latter part of September 1864 Gen. Grant ordered a movement against the Confederate troops north of James River, defending Richmond. Grant hoped to make Gen. Lee so weaken the garrison at Petersburg that the Union forces might carry it. The great object, however, was to prevent Lee sending reinforcements to Early in the Shenandoah Valley. September 28, during the night, Gen. Ord crossed from the south to the north bank of the James, and on the 29th, with 4,000 men, driving before him the Confederate outposts, appeared before Fort Harrison, on Chaffin's Farm, the strongest work on the Confederate line. Birney, with 10,000 men, moved by roads farther to the right. Stannard's division, which led the advance of Ord's column, moved to the assault of Fort Harrison, under a very severe fire of artillery and musketry, and after a sharp encounter carried it with its 16 guns and nearly 300 prisoners, at a loss of over 500.

Ord, being severely wounded, the command of his corps fell to Gen. Heckman, whose division, following Stannard's, passed to the right of Fort Harrison, attacked Fort Gilmer, and was repulsed with heavy loss. Meanwhile Gen. Birney had advanced on the New Market road, captured some of the advanced rifle-pits, running northeast from Fort Harrison, and established connection with Heckman. Gen. Grant now appeared and ordered an advance on the right. At 3 P.M. Birney made another assault upon Fort Gilmer, but was badly repulsed. Grant ordered the troops to entrench. Gen. Lee transferred seven brigades from his lines at Petersburg to the north side of the river, and massed 10 brigades at and near Fort Gilmer to assault and retake Fort Harrison. The assault was made at 2 P.M. of the 30th by Gen. R. H. Anderson, commanding Longstreet's corps, with five brigades, and was repulsed. Twice the Confederates re-formed and renewed the assault, but were repulsed, leaving a large number of killed and wounded and seven battle-flags on the ground, and the effort to dislodge the Union troops was abandoned. The Union loss on the 29th and 30th was 383 killed, 2,299 wounded, and 645 missing, an aggregate of 3,327. The loss of the Confederates is not definitely known, but it was near 2,000 in killed, wounded, and missing. Consult: 'Official Records,' Vol. XLII.; Humphreys, 'The Virginia Campaign of 1864-65.'

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Fort Henry and. Fort Donelson. These forts were constructed by the Confederates just south of the boundary line between Kentucky and Tennessee, the former on the right bank of the Tennessee River, the latter on the left bank of the Cumberland; the distance between the two being 12 miles. On 28 Jan. 1862 Commodore Foote and Gen. Grant asked Gen. Halleck's permission to take Fort Henry. Halleck assented, and on the morning of 2 February Foote's flotilla of ironclads and gunboats, followed by a fleet of transports, carrying Grant's troops, left Cairo, anchoring 6 miles below Fort Henry on the morning of the 4th. The fort was defended by 17 heavy guns, and its land approach was covered by rifle-pits held by 3,000 men. Gen. Lloyd Tilghman was in command. About 11.20 A.M. of the 6th Foote steamed up toward the fort and attacked it with four ironclads, Tilghman, with about 90 men to work 11 guns bearing on the river, returning the fire. After a contest of an hour and a quarter Tilghman hauled down his flag and surrendered with 78 men, having lost 16 killed and wounded. The 3,000 men in the rifle-pits retreated to Fort Donelson. The fleet had 29 killed and wounded. Grant, who had landed his troops 6 miles below the fort, arrived too late to take part in the action.

Grant reported to Halleck that on the 8th he would take and destroy Fort Donelson. Foote, however, was compelled to return to Cairo for repairs to his fleet, and the movement was deferred until the morning of the 12th, when Grant marched across the country, with about 16,000 men, arriving before Fort Donelson in the evening. The fort was on a commanding hill, 120 feet above the level of the Cumberland, with three heavy batteries commanding the river, and a line of rifle-pits to defend the land approach. On the morning of the 13th the fort and works were held by 18,000 men, under command of Gen. Floyd. The rifle-pits 2½ miles in extent, were held by Gen. Buckner on the right and Gen. Pillow on the left.

Grant formed his line of investment with Gen. McClernand on the right and Gen. Smith on the left, and at dawn of the 13th opened a furious cannonade and sharp skirmishing. In the evening Foote's flotilla and reinforcements for Grant arrived — Crufts' brigade and several regiments from Fort Henry and Cairo. These were formed into a division of 10,000 men, under Gen. Lew Wallace, and put in the line between McClernand and Smith, raising Grant's force to 26,000 men. At 2 P.M. of the 14th Foote attacked the fort, and at the end of an hour and a half was compelled to withdraw, two of his ironclads being entirely disabled and the other two partially so. He had 54 men killed and wounded. It was then concluded that Foote should return to Cairo and repair damages, while Grant should perfect his investment, fortify his lines, and await the arrival of reinforcements and the return of Foote.

The Confederates shaped the course of events otherwise. They decided to break the right of Grant's investing line and escape by roads leading to Nashville. In pursuance to the plan adopted, Pillow, on the Confederate left, supported by a part of Buckner's command, advanced at daybreak of the 15th, with 10,000 men, and after a hard fight gained the right of McClernand's line and forced it back. McClernand called for assistance and, in the absence of Grant, who had gone to confer with Foote, Lew Wallace sent Crufts' brigade to his support, but the Confederates continued to gain the advantage, pushing back McClernand's two right brigades and their supports. Buckner made an attack upon McClernand's left and was repulsed; but rallying his men, he renewed the attack, and the whole right wing of Grant's army was forced back, the Confederates still following up their advantage, when Wallace threw Thayer's brigade to the right and across their line of advance and, after a sharp fight, checked them, driving some back to their entrenchments. It was 2 P.M. when Grant came on the field to find nearly half his army driven from position and the way open for Confederate escape. He ordered a counter-attack. Smith, commanding on the left, formed a brigade in column, led it under severe fire, and seized the Confederate works in his front and on the high ground surrounding the fort. Wallace and part of McClernand's force, advancing on the right, gained the greater part of the ground lost early in the day, and by night the line of investment was re-established. Grant made preparations to renew the attack early next morning, but during the night the Confederate commanders came to the conclusion that escape was impossible, that Grant was too strong to be beaten, and that nothing remained but a surrender. Floyd, senior in rank, announced personal reasons against a surrender and passed the command to Pillow, who in turn passed it to Buckner. Floyd and Pillow, with the aid of two small steamboats, succeeded in getting away with about 1,200 officers and men, principally of Floyd's old brigade, and Col. Forrest, with some 500 cavalry and other small detachments, escaped in the night by the river road.

At an early hour of the 16th, as Grant was about to renew the attack Buckner sent him a note proposing "the appointment of commissioners to agree upon the terms of capitulation," and suggesting an armistice until 12 o'clock. Grant replied: "No terms except unconditional and immediate surrender can be accepted. I propose to move immediately upon your works." Buckner surrendered 14,500 men, 57 guns, and a large amount of ammunition and stores. The Union loss, army and navy, was 510 killed, 2,152 wounded, and 224 missing. The Confederate loss, killed and wounded, was about 2,000.. The capture of Forts Henry and Donelson broke the first line of Confederate defense in the Mississippi Valley, and caused the abandonment of Columbus, Bowling Green, and Nashville. Consult: 'Official Records,' Vol. VII.; Force, 'From Fort Henry to Corinth'; Swinton, 'Decisive Battles of the War'; The Century Company's 'Battles and Leaders of the Civil War,' Vol. I.; Grant, 'Personal Memoirs,' Vol. I.

E. A. Carman.

Fort Hindman, or **Arkansas Post, Battle of.** After Gen. Sherman's failure at Chickasaw Bayou (26–31 Dec. 1862), his army and Admiral Porter's fleet returned to Milliken's Bend, where, 4 Jan. 1863, Gen. J. A. McClernand superseded Sherman in command and moved against Fort Hindman, situated on the north bank of the Arkansas River, 50 miles from its mouth, commanding the approach to Little Rock and protecting the valley of the Arkansas. The fleet, 3 ironclads and 6 gunboats, entered White River, and from it passed through a cut-off to the Arkansas, 9 January. The army of 29,000 men landed about four miles below the fort, a large square-bastioned work, on high ground, at the end of a horseshoe bend in the river, mounting 18 guns, and garrisoned by about 5,000 men, under command of Gen. T. J. Churchill. A line of rifle-pits surrounded it. The ironclads began the attack on the 10th, and the entire fleet, gradually moving up, shelled the Confederates out of the rifle-pits and back into the fort. On the 11th the navy opened a furious fire upon the fort, McClernand's artillery joining in the fire from the land side. Churchill's guns were silenced, and McClernand ordered a general assault. After a severe contest the fort was carried with a loss to the Union army of 134 killed, 898 wounded, and 29 missing. The naval loss was 6 killed and 25 wounded. The Confederate loss was 60 killed, about 80 wounded, and 4,791 captured. On the 12th McClernand received peremptory orders from Gen. Grant to return to Milliken's Bend with his entire command. The prisoners were sent to St. Louis, the fort was dismantled and blown up, and the fleet and troops went down the Arkansas to Napoleon, on the Mississippi. Consult: 'Official Records,' Vol. XXII.; Greene, 'The Mississippi'; Mahan, 'The Gulf and Inland Waters'; Maclay, 'History of the Navy,' Vol. II.; The Century Company's 'Battles and Leaders of the Civil War,' Vol. III.

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Fort Holmes, Mich. See Mackinac Island.

Fort Howard, Md. See Military Posts, U. S.

Fort Independence, Mass. See Military Posts, U. S.

Fort Jackson and **Fort St. Philip.** Fort Jackson was built between 1824 and 1832 on the right bank of the Mississippi, about 80 miles below New Orleans. Together with Fort St. Philip on the opposite bank, half a mile above, it defended the city from water attack. Both forts were seized by Louisiana State troops 11 Jan. 1861, were strengthened and garrisoned, and remained in Confederate possession until taken by Admiral Farragut in April 1862, at which time they were garrisoned by about 700 men each. Fort Jackson was armed with 74 guns, Fort St. Philip with 52. In March 1862 Farragut assembled a powerful fleet at Ship Island and at Southwest Pass, at the mouth of the Mississippi, for the capture of New Orleans, and 18 April Commodore Porter, in command of a strong flotilla, opened fire upon Forts Jackson and St. Philip. During six days he threw 16,000 shells, but was unable to reduce the forts.

It was found necessary to run past the forts and destroy the Confederate navy above before New Orleans could be taken. On the 24th Farragut, with 17 vessels, in single line, carrying 192 guns, steamed up the river, engaging both forts with heavy broadsides, of shot, shell, and canister, receiving heavy fire in return. Passing the forts and obstructions, he engaged and destroyed the Confederate fleet, in one of the most spectacular naval battles of the War. Within an hour and a half after leaving its anchorage Farragut's fleet had passed the forts and destroyed 11 Confederate vessels. With 13 of his own vessels Farragut proceeded up the river, and at noon of the 25th anchored before New Orleans, which was abandoned by the Confederate troops holding it, and surrendered by the civil authorities. Porter, who had remained below, continued his bombardment of the forts, which were surrendered on the 28th. The Union loss was 37 killed and 147 wounded. The loss in the forts was 14 killed and 39 wounded; that in the Confederate navy is not known. Consult: The Century Company's 'Battles and Leaders of the Civil War,' Vol. II.; Mahan, 'The Gulf and Inland Waters'; Maclay, 'History of the Navy,' Vol. II.

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Fort Keogh, Mont. See Military Posts, U. S.

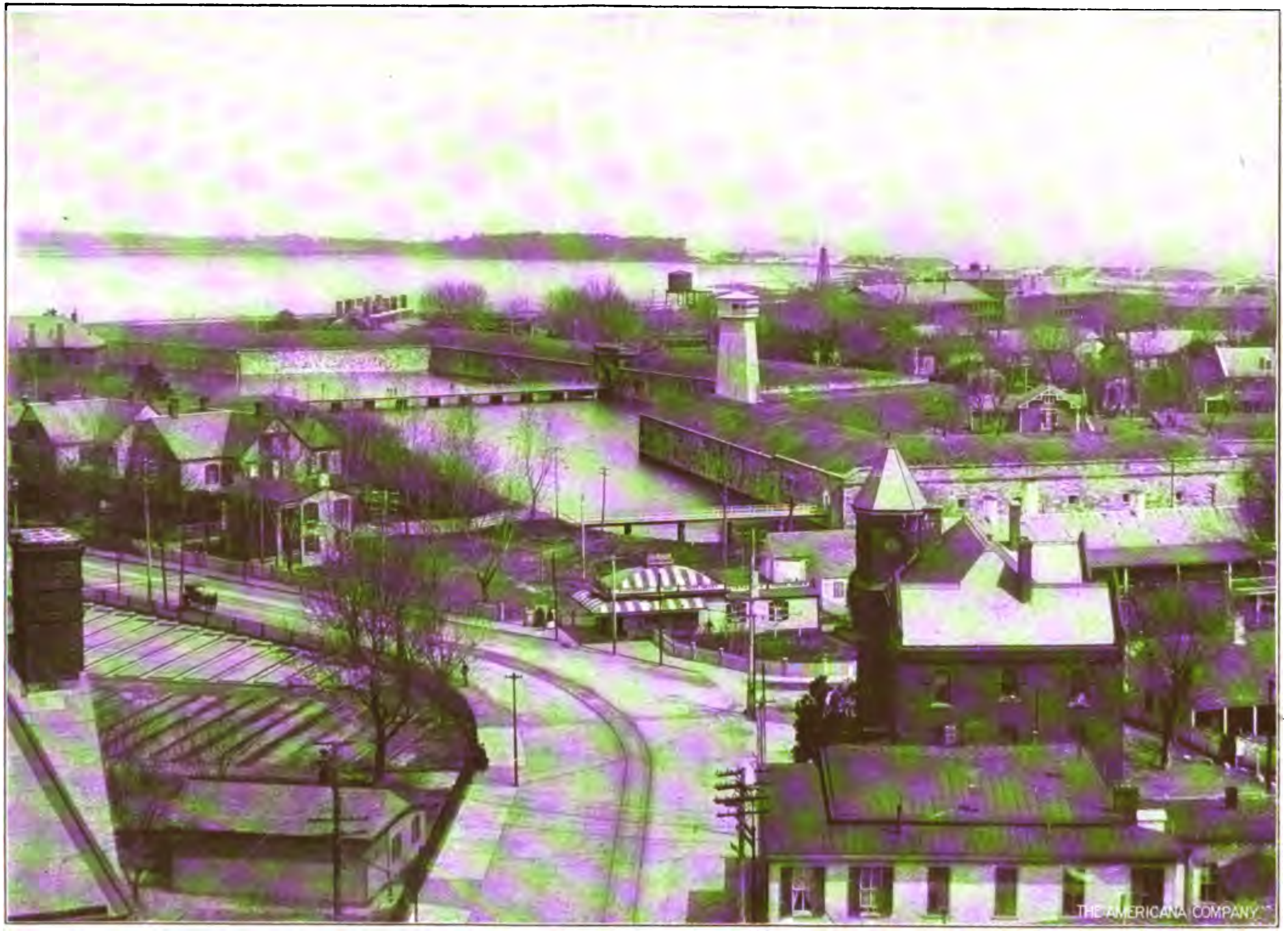
Fort Lafayette, N. Y. See Military Posts, U. S.

Fort Leavenworth, lev'en-worth, Kan., a United States military post and reservation, three miles from Leavenworth, established in 1827. There is here a military prison and national cemetery.

Fort Lee, N. J., a former fort in Bergen County, on the west bank of the Hudson River. On 20 Nov. 1776 Gen. Greene and the American forces evacuated Fort Lee, and narrowly escaped capture by 5,000 British under Cornwallis.

Fort Logan, Colo. See Military Posts, U. S.

Fort McAllister, an earthwork erected by the Confederates at Genesis Point as one of the defenses of Savannah. It was 12 miles south of the city and 6 miles from Ossabaw Sound. On 27 Jan. 1863 Admiral Dupont attacked it with five vessels, and again on 1 February, but without effect. On 3 March three monitors,



FORTRESS MONROE. OLD POINT COMFORT, VA.

under command of Commodore Drayton, bombarded it, but did little injury. When Sherman, marching from Atlanta, appeared before Savannah the fort prevented communication between his army and the Union fleet, and Hazen's division of the Fifteenth corps was ordered to assault it. Hazen reached the vicinity of the fort about 11 A.M., 13 Dec. 1864, drove in the Confederate skirmishers, and at 4.15 P.M. had deployed nine regiments within 600 yards of the work. At that time the bugle sounded, and the line went forward over exploding torpedoes and under a close and severe fire of artillery and musketry, carrying the fort at 5 P.M. and capturing its garrison of about 250 men, 22 guns, and a large amount of ammunition. The Union loss was 24 killed and 110 wounded. The Confederate loss was about 50 killed and wounded.

E. A. CARMAN.

Fort McHenry, Md., a United States military post, on the Patapsco River, established in 1794. It was bombarded in 1814 by the British fleet, and was used as a rendezvous during the Civil War. See MILITARY POSTS, U. S.

Fort McPherson, Ga. See MILITARY POSTS, U. S.

Fort Macon, a work commanding Beaufort Harbor, N. C., constructed of brick and stone, and mounting nearly 50 guns. It was seized by Gov. Ellis, of North Carolina, about the middle of April 1861. After Burnside's capture of Newbern, 14 March 1862, Gen. Parke was sent to reduce the fort, then garrisoned by about 450 men. Parke captured Moorehead City and Beaufort, and then proceeded to invest the fort He cut off its communications, planted 11 siege-guns, and at 5:40 A.M.' 25 April, in co-operation with four vessels of the navy, opened fire, and at 4 P.M. the fort surrendered with its entire garrison. Parke occupied it next morning and it remained in Union possession until the close of the War.

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Fort Madison, Iowa, a city and county-seat of Lee County, 18 miles from Burlington, on the Chicago, B. & Q. R.R. Here is the State penitentiary and the Catermole Memorial Library. There was a fort here as early as 1808, but was abandoned in 1832 when the town was established. Pop. (1910) 8,900.

Fort Meade, S. D. See MILITARY POSTS, U. S.

Fort Meigs, mĕgz, Ohio, a former fort on the Maumee River, where the Americans made a gallant defense in 1812 against the British and Indians. See FRENCHTOWN.

Fort Mer'cer, N. J., a former fort at Red Bank, on the Delaware River, that figured somewhat prominently in the Revolution. It was destroyed by the British 20 Nov. 1777.

Fort Mif'flin, Pa., a United States military post on Mud Island in the Delaware River. It was built in 1771 as one of the defenses for Philadelphia. It figured in numerous engagements in the Revolution. It is garrisoned at the present time. See MILITARY POSTS, U. S.

Fort Mims, Ala., Massacre of, a massacre of whites by Creek Indians at the temporary stockade, near Mobile, Ala., 30 Aug. 1813. Over 500 men, women, and children were killed by a large force of Indians under Weathersford, a half-breed.

Fort Monroe, Va., a United States military post at Old Point Comfort, commanding the entrance to Hampton Roads. Jefferson Davis (q.v.) was kept a prisoner here for two years after the Civil War.

Fort Montgomery, N. Y. See MILITARY POSTS, U. S.

Fort Morgan, Ala. See FORT GAINES AND FORT MORGAN.

Fort Moultrie, mōl'trĭ, S. C. When Major Anderson transferred his garrison from Fort Moultrie to Fort Sumter, 26 Dec. 1860, he spiked and dismounted the 52 guns of the fort and burned the gun carriages. The South Carolina authorities took possession of the fort on the 27th, remounted the guns, strengthened the work, increased its armament, and it became one of the strong defenses of Charleston Harbor, resisting all efforts of the Union fleet to pass it, or reduce it, and remained in Confederate possession until the evacuation of Charleston and all the forts in the harbor 17–18 Feb. 1865. See FORT SUMTER; FORT WAGNER. For early history see FORT SULLIVAN.

Fort Myer, Va. See MILITARY POSTS, U. S.

Fort Necessity. After the capture of Jumonville's force (see GREAT MEADOWS), Washington threw up earthworks and made a stockade fort, which he named as above. It soon became crowded with Indians and colonial companies, and a South Carolina company of regulars under Capt. Mackay; and Washington left the latter in command and moved 13 miles farther on, where was a small settlement. But the place was indefensible; and after summoning Mackay and his men it was decided to retreat to Fort Necessity. The next morning the French were upon them, 900 men besides Indians. Washington led out his men to battle, but the enemy kept off and fired from the woods, in a heavy rain. Washington withdrew his men behind the low, flimsy embankment; and after an entire day of mutual firing, with heavy loss on both sides, the French proposed a parley. The English were at the last extremity, with food and ammunition nearly exhausted, and guns in bad condition; and Washington would not consent to let them send an officer to his camp to observe this, and only yielded when they proposed to have him send one to theirs. The French terms were that the English should retire with all their baggage except artillery, agree to build no more forts beyond the Alleghanies for a year, return the Jumonville prisoners, and leave two officers with the French as hostages. The terms were accepted; but had the French held out a few hours more they could have killed or captured the entire force.

Fort Niag'ara, N. Y. As early as 1669 La Salle built a stockade at the mouth of the Niagara River, and Fort Conti, a fortified trading post was built here 10 years later. In 1686 it was called Fort Denonville and in 1725 it was named Fort Niagara. In July 1759 it was captured by the British and Indians under Johnson (see COLONIAL WARS), and was again captured by the British 19 Dec. 1813.

Fort Ninety-six, S. C. See NINETY-SIX.

Fort Payne, Ala., a city and county-seat of Dekalb County, on the Alabama G. S. R.R. It has large coal and iron industries. Pop. 1,300.

Fort Pickens, a strong work on Santa Rosa Island, Fla., commanding the entrance to Pensacola harbor, and with Forts Barrancas and McRee opposite, defending the harbor and United States navy-yard at Warrington. Early in January 1861 it was under command of Lieut. A. J. Slemmer and practically unoccupied, Slemmer, with a small garrison, being at Fort Barrancas. Fearing that the secessionists would seize the fort, Slemmer, 10 January, transferred to it his garrison of 81 men from Barrancas, and on the 12th the governor of Florida seized Forts Barrancas and McRee, with 175 heavy guns, also the navy-yard, and demanded the surrender of Fort Pickens, which was refused. A second demand was made on the 15th and a third on the 18th, both of which were refused. Slemmer strengthened the work and held it until relieved by the arrival of reinforcements 12–13 April, when Col. Harvey Brown assumed command. Additional reinforcements were sent, and in June a regiment of New York troops, known as Wilson's Zouaves, was landed on Santa Rosa Island and encamped. On 9 October a body of Confederate troops, that had crossed from Pensacola and landed on the island during the night, surprised the camp of the Zouaves, and drove them back toward Fort Pickens, but the Zouaves being reinforced by four companies from the fort, the Confederates were driven in disorder to their vessels, with a loss of about 90 killed, drowned and wounded. The Union loss was 67 killed, wounded, and captured. No other serious attempt was made upon the fort, which remained in Union possession until the close of the War.

E. A. Carman.

Fort Pillow, constructed by the Confederates on the east bank of the Mississippi, about 40 miles above Memphis. It was bombarded by the Union fleet in its descent of the river and attack upon the Confederate fleet near Memphis, abandoned by the Confederates 4 June 1862, and 5 June was occupied by a small Union force. On 12 April 1864 it was garrisoned by parts of the 2d and 4th (colored) U. S. Artillery, and a detachment of the 13th Tennessee Cavalry, in all 557 men, with six guns, under command of Maj. L. F. Booth. At daybreak of the 12th Gen. J. R. Chalmers, of Forrest's cavalry command appeared before the fort with about 1,500 men, and after some hours of hard fighting drove the Union troops from their advanced rifle-pits back into the fort, which was attacked, and the Confederates repulsed, but securing a sheltered position within 100 yards of it. Forrest had come up while the fighting was in progress, and at 3.30 P.M. demanded the surrender of the fort, saying that he had sufficient force to take it, and would not be answerable for consequences should he be compelled to assault. Maj. Booth had been killed, but in his name an hour was asked for consideration. There were U. S. gunboats in the river, and believing that the request for an hour's consideration was to gain time for reinforcements to arrive, Forrest would give but half an hour. When the time was up the bugles sounded the charge, the assault was made, there was a short and severe struggle, many of the garrison were killed in the fort, and those who attempted to escape by the river were shot or, rushing over the bluff into the river, drowned. More than half of the garrison were killed or wounded, a very large proportion being killed. About 160 white and 40 colored prisoners were taken. The defenders of the fort fought bravely, but were simply overpowered. Forrest says in his report: "The river was dyed with the blood of the slaughtered for 200 yards. The approximate loss was upwards of 500 killed; but few of the officers escaped. There was in the fort a large number of citizens who had fled there to escape the conscript law. Most of them ran into the river and were drowned." Forrest reports his own loss as 20 killed and 60 wounded. Consult: 'Official Records,' Vol. XXXII.; The Century Company's 'Battles and Leaders of the Civil War,' Vol. IV.

E. A. Carman.

Fort Porter, N. Y., a United States military post on the Niagara River in the city of Buffalo. It was established in 1867, but prior to that date the government maintained a defensive work at Black Rock.

Fort Preble, Me., a United States military post, at Spring Point, in Portland Harbor, established in 1808.

Fort Pulaski, erected by the United States on Cockspur Island, for the defense of Savannah, Ga., and commanding both channels of the Savannah River. It was a brick work, with walls 7½ feet thick and 25 feet high above water. It was seized by Georgia State troops 3 Jan. 1861, and in January 1862 mounted 48 heavy guns and was garrisoned by nearly 400 men. Gen. Q. A. Gillmore was put in charge of operations to reduce it, and in February 1862 2 regiments of infantry, 2 companies of engineers, and 2 of artillery were landed on Tybee Island, mostly a mud-marsh, lying southeast of the fort, and soon constructed 11 batteries of 36 heavy guns, at distances from the fort varying from 1,650 to 3,400 yards. Causeways had to be constructed across marshes, over which mortars of 17,000 pounds were moved; the work was done entirely at night; all difficulties were overcome; and on 9 April the batteries were ready to open fire, the three breaching batteries being established at a mean distance of 1,700 yards from the fort. At sunrise of the 10th the fort was summoned to surrender; its commander, Col. C. H. Olmstead, replied that he was there "to defend the fort, and not to surrender it." Fire was opened at 8 A.M., and an hour later all the batteries were in full play, the Confederates replying vigorously, the fire continuing on both sides until dark. Firing was resumed at sunrise of the 11th, and the Confederates replied steadily; but by noon several of the guns were dismounted; the walls of the fort began to crumble under the weight of metal; and at 2 P.M. the white flag was raised, firing ceased, and 385 officers and men were surrendered, several of whom were severely, one mortally, wounded. The Union loss was one man killed. The result of the fall of Fort Pulaski was the closing of the Savannah River to blockade runners.

E. A. Carman.

Fort Riley, Kan., a United States military post on the Kansas River, near Junction City, Kan. It was established in 1852 on a reservation of 19,000 acres and was first called Camp Centre. It is about 140 miles from Fort Leavenworth, with which place it is connected by a military road completed in 1854. An appropriation of $100,000 was made by Congress in 1855 for the extension of this road to Bridger's Pass, between Nebraska and Utah, making it one of the finest roads in the country. The fort is the seat of the United States Cavalry and Field Artillery School and has accommodations for a large force of cavalry and infantry.

Fort Robinson, a United States military post in the Red Cloud Agency, situated in the western part of Dawes County, Nebraska, and on a fork of the White River, about three miles southeast of Crawford. The post dates back to 1874 and occupies about 20 square miles. There are accommodations for over 500 troops, with stables for the same number of horses.

Fort Royal, West Indies. See FORT DE FRANCE.

Fort Saint David, a town in the presidency of Madras, Hindustan, on the Coromandel coast, situated on the Tripapolore River, about 12 miles south-southwest of Pondicherry. It was besieged by the French in 1746, but withstood the siege and finally forced the French to retire. It remained in possession of the British and was the capital of their possessions in that section of India until 1750, when the French army under Gen. Lally again attacked the fort, this time with success, and razed the fortifications.

Fort St. Philip, La., a fort lying on the Mississippi River about 80 miles below New Orleans and nearly opposite Fort Jackson. The Spaniards originally built the old river front and it was not until the War of 1812 that the works were entirely enclosed by the United States government. Extensive alterations were made by the government after 1841. At the outbreak of the Civil War it was taken by the Confederates, but fell before the attack of Admiral Farragut's fleet in April 1862. See FORT JACKSON AND FORT ST. PHILIP.

Fort Sam Huston, hŭs'tŏn, Texas, a United States military post near San Antonio, established in 1865. There is a reservation here of 469 acres.

Fort Sanders. See KNOXVILLE, SIEGE OF.

Fort Schuyler, New York harbor. See MILITARY POSTS, U. S.

Fort Schuyler (Old), N. Y. See FORT STANWIX; ROME, N. Y.

Fort Scott, Kan., city and county-seat of Bourbon County; on the Marmaton River, and on the Saint Louis & S. F., the Missouri, K. & T., and the Missouri P. R.R.'s., 100 miles south of Kansas City.

Industries.— The chief income of the city is derived from the railroad shops, the Saint L. & S. F. employing 500 hands and the Mo. Pac. 550 hands. The city is situated in a rich agricultural region, this in itself a valuable source of income. Besides these industries there are manufactories of cement, syrup, brick and machinery. Fort Scott is also the largest horse and mule market in the State.

Banks, Public Buildings, etc.—There are three banks with a combined capitalization of $200,000. Among the public institutions are the library containing 18,000 volumes, the Goodlander Home for Children, the old government fort buildings which have been preserved, and the National cemetery.

Church and Educational Institutions.— Religious services are held in 11 church edifices. The educational system is excellent, consisting of a high school and seven public schools. There are two commercial colleges in the city and the Notre Dame De Lourdes Academy is also located there.

History, Government and Population.— The city was first settled as a military post in 1844, became a municipality in 1850 and was chartered as a city of the first class in 1882. The public administration is vested in a mayor, and a city council composed of 10 members, five of whom are elected each year. The major portion of the population are native born, with a sprinkling of negroes, Germans, Jews, and Irish. Pop. (1890) 11,946; (1900) 10,322; (1910) 10,463.

GEORGE W. MARBLE,
Editor 'Tribune and Monitor'.

Fort Smith, Ark., city and county-seat of Sebastian County, situated on the western border of the State at the junction of the Arkansas and Poteau rivers, and on the Saint Louis & S. F., Missouri P., Kansas City S., Midland Valley, F. S. & W., and Ark. Cent. R.R.'s.

Industries.— The city is in a rich agricultural region and derives a greater part of its income from this source. There are also coal mines near by. The city has a wagon factory, several furniture and chair factories, a wood-working establishment, machine shops, cotton compress, and oil wells. There are two daily and several weekly papers published.

Schools and Churches.— The city has eight public schools, a high school, two commercial colleges, a Catholic Girl's Academy, three parochial schools, and two conservatories of music. There are 13 churches, representing nearly all denominations.

Banks, Public Buildings, etc.— There are four banks (three national and one savings), having a combined capital of $900,000. Among the notable public buildings are the Federal and County court-houses, the United States jail, and a hospital and an opera-house. A National cemetery is located on the site of the former "Post" burying ground.

History, Government and Population.— Fort Smith was originally a French trading post, and in 1817 became the headquarters for the gathering and distribution of supplies for the United States army in the Southwest. It was called Belle Point by the early settlers, was incorporated in 1842, and received its city charter in 1886. The city is governed by a mayor, a board of public affairs, and a council of 10 members elected for two years. The city is lighted by electricity, gas, and natural gas, owns its waterworks, and possesses an excellent system of electric railways. Pop. (1900) 11,587; (1910) 23,975.

E. B. MILLER,
Secretary Commercial Club.

Fort Snelling, Minn. See MILITARY POSTS, U. S.

Fort Stanwix, N. Y., a former fort near the present site of Rome, N. Y., originally built in 1756, but abandoned, and rebuilt in 1758 by

Brigadier Stanwix. Here in the fall of 1768 a treaty was negotiated by Sir William Johnson (q.v.), the British superintendent-general of Indian affairs in North America, with the Six Nations, about 3,200 Indians being present. For the sum of $10,000, the Indians surrendered title to Kentucky, West Virginia, and western Pennsylvania. Soon after this the fort was again abandoned, but in 1776 it was once more rebuilt and named after that intrepid old soldier, Gen. Philip Schuyler. In 1777 the fort was the object of an attack by Gen. Saint Leger with 1,700 British soldiers and allies, but the garrison held out for 19 days, from 3–22 August when they were relieved by a force of Continentals under Gen. Arnold. In 1781 the fort was destroyed by flood and fire, and when rebuilt was again named Fort Stanwix. It was here on 22 Oct. 1784 that the three United States commissioners negotiated the treaty with the Iroquois Indians, known as the "Treaty of Fort Stanwix," which provided for the cession to the United States of western lands claimed by them.

Fort Stedman, Assault on. In March 1865 Gen. Lee prepared to abandon Richmond and Petersburg, unite with Johnston at Danville, and attack Sherman, who was marching northward from Savannah. In order that he might wait for favorable weather, he decided on a sortie against Grant, to hold him near the Appomattox. The sortie was committed to Gen. Gordon, with about one half of the army. The point of Gordon's attack was Fort Stedman. At 4 A.M. 25 March the attack was made, and a rush of Gordon's men overcame the pickets and advance guards, took from 400 to 500 yards of the main line (Willcox's), including Fort Stedman, the defenders of which, after a spirited resistance, were overpowered and captured, turned its artillery upon the Union line, captured between 500 and 600 prisoners, and endeavored to sweep down the intrenchments, but met with a repulse. It was so dark that friend could not be distinguished from foe, but Gen. Parke ordered Willcox to recapture the works, Gen. Hartranft to support him. By 7.30 A.M. Parke had regained a part of the line and drawn a cordon around Fort Stedman, and Tidball's artillery had concentrated a heavy fire upon it and the line adjacent. Hartranft advanced at 7.45 A.M., attacked detachments of the enemy that were moving in the direction of City Point, capturing or driving them back, and at 8 A.M. Fort Stedman and the entire line was recaptured, together with 1,949 prisoners and 9 stands of colors, the Federal loss (Ninth corps) being 72 killed, 450 wounded, and 522 missing. The Sixth corps now attacked and captured the Confederate picket-line, losing 449 killed and wounded, and 30 missing; and the Second corps did the same, capturing 365 prisoners, and losing 51 killed, 462 wounded, and 177 missing. The Confederates made several efforts to recapture their own advanced lines, but failed. The entire Union loss in this engagement was 170 killed, 1,323 wounded, and 729 missing, an aggregate of 2,222. The Confederate loss is not definitely known: Gen. Meade estimates it at 5,000 men; it was probably not over 4,000, of whom one half were prisoners. Consult: 'Official Records,' Vol. XLVI.; Humphreys, 'The Virginia Campaign of 1864–65'; Walker, 'History of the Second Army Corps'; Powell, 'History of the Fifth Army Corps'; The Century Company's 'Battles and Leaders of the Civil War,' Vol. IV.

E. A. CARMAN.

Fort Stephenson, Ohio. See FREMONT, Ohio.

Fort Stevens, a United States military post in Oregon, situated in the extreme northwestern part of the State at the mouth of the Columbia River. It is a little more than 100 miles northwest of Portland and about 9 miles west of Astoria, the fur trading post, which was established by John Jacob Astor in 1811. The grounds surrounding the post which was established in 1864 comprise 1,250 acres, and, beside the quarters for the officers and artillerymen stationed there, has a post office and railway station.

Fort Sullivan, S. C., the early name of Fort Moultrie, in Charleston harbor; notable for its defense against the British in the Revolutionary War. See COLONIAL WARS.

Fort Sumter, built upon a shoal in the narrowest part of the channel of Charleston harbor, three and a half miles from the city, and three fourths of a mile from the north end of Morris Island, was constructed on a rip-rap foundation, its walls of brick being 38 feet high and 7½ feet thick. When South Carolina secede the fort was unfinished and not garrisoned, but men were engaged in the work and in mounting guns. South Carolina passed an ordinance of secession on 20 Dec. 1860, and the secessionists looked to the immediate possession of all the forts in the harbor, one of which, Fort Moultrie, was held by Maj. Robert Anderson, with a garrison of 75 men. Fort Moultrie was indefensible from a land attack, and Anderson, believing that he was about to be attacked, on 26 December, skilfully transferred his command to Fort Sumter, the strongest and most inaccessible work in the harbor. Gov. Pickens demanded Anderson's immediate return to Fort Moultrie. Anderson refused, and the governor took possession of Fort Moultrie and all other works in the harbor, and seized the arsenal, post-office and custom-house in Charleston, raised the Palmetto flag over them, and thus inaugurated war against the United States. He began the construction of batteries on James, Morris, and Sullivan islands to command the harbor and reduce Fort Sumter. On 9 Jan. 1861 the merchant steamer Star of the West endeavored to land reinforcements and provisions for Fort Sumter, but was fired upon by the secession batteries and driven back. Again Gov. Pickens demanded the surrender of the fort, again Anderson refuced, and negotiations were transferred to Washington. The construction of batteries continued and 1 March Gen. Beauregard was assigned to the command of all the Confederate forces at Charleston, with instructions to perfect preparations for reducing Fort Sumter. Anderson was now in danger of being starved out and, in accordance with promise given, Gov. Pickens was informed 8 April by a special messenger sent by President Lincoln, that an attempt would be made to land provisions, and provisions only, at Fort Sumter. Beauregard notified the Confederate government, and received orders 10 April to demand the evacuation of the fort, and to reduce it if refused. The demand was made at noon of the 11th. Anderson refused, but made the casual remark to the messengers carrying Beauregard's demand that, if left alone, he would be starved out in a few days, and Beauregard, "to avoid effusion of blood," asked when he would be ready to leave the fort. Anderson said he would evacuate the fort by noon of the 15th, should he not prior to that time receive "controlling instructions" from his government or "additional supplies." The reply was not satisfactory, and 3.20 A.M. of the 12th Anderson was notified that fire would be opened within an hour. At 4.30 A.M. the signal-gun was fired from Fort Johnson on James Island; all the batteries opened fire; Anderson replied deliberately; in 24 hours 2,500 shot and shell struck the fort or fell inside of it; the barracks were burned and the fort much damaged; the relieving fleet could not land; and on the afternoon of the 13th terms were arranged under which, on the afternoon of the 14th, Anderson saluted his flag and, with drums beating and colors flying, marched with his garrison out of the fort, was conveyed to a steamer, and sailed for New York. During the bombardment not a man was killed on either side.

When Fort Sumter fell into Confederate possession it had 78 serviceable guns. Additional guns were mounted in it and it was well garrisoned. The Union authorities sunk a number of old whalers filled with stones in the main channel of Charleston harbor to close the port to blockade-runners, and a blockading force was maintained off the harbor; but it was not until 7 April 1863 that any serious operation was attempted against the fort. Then Dupont, with nine ironclads, made an unsuccessful attack upon it. One of the ironclads, the Keokuk, which had approached nearest to the fort, was struck 90 times, and so much injured that she sunk off Morris Island, and her armament fell into the hands of the enemy, while the others withdrew after an engagement of 40 minutes, most of them being considerably disabled by the fire of the 69 heavy guns brought to bear upon them. The fleet fired 151 shots, not more than 34 of which struck the walls of the fort. Sumter discharged 810 shot, Fort Moultrie and other batteries 1,399, in all 2,209, of which 520 struck the different vessels. It had been expected that the fort would be reduced to a pile of ruins before the sun went down, but the result convinced the Union authorities that the fort and adjoining works could not be reduced by a purely naval attack.

It was now determined that Fort Sumter and Charleston should be taken by combined land and naval attacks, the land attack being by way of Morris Island, the capture of the batteries there, and the establishment of batteries to reduce Fort Sumter. For this purpose Gen. Gillmore was selected. He landed on Morris Island 10 July, made two unsuccessful assaults on Fort Wagner, 11 and 18 July, and then concluded to attempt the destruction of Sumter from ground already in his possession, so that the fleet could enter the harbor and command Charleston. (See FORT WAGNER.) A sufficient number of breaching-guns were in readiness 16 August; fire was opened on the 17th, and on the 24th Gillmore reported the practical demolition of the fort. From 18 guns he had thrown 5,009 projectiles, weighing 552,683 pounds, of which 4,147 struck the fort. Before daylight 23 August five monitors approached to within about 800 yards of the fort and opened fire, which was kept up until 6 A.M. Confederate officers now held a council, and the proposition was offered to abandon the fort, but as a matter of sentiment it was resolved to hold it. On 30 August Gillmore resumed fire, dismounting the remaining barbette guns and leaving but one casemate gun serviceable. As a means of defense against the fleet the work was entirely useless, and it was held merely as an infantry outpost. On 2 September six monitors opened fire on it, but it remained silent, not a single gun being in working order to reply. Early on the morning of 7 September, after the abandonment of Fort Wagner, Admiral Dahlgren demanded the surrender of Fort Sumter, which was refused. Meantime the Confederates were removing the guns from the fort and placing them in other parts of the harbor. During the night of 8 September a naval force of about 400 men, under Commander F. H. Stevens, atempted to carry the fort by assault. It was then defended by about 450 men, under command of Maj. Stephen Elliott, Jr. Stevens' men were in boats, and when towed within 800 yards of the fort the boats were cut loose and rowed for the fort, on approaching which they were met with a fire of musketry; as the men landed, hand-grenades and shells were thrown upon them; and simultaneously, at a signal from the fort, all the Confederate batteries on James and Sullivan islands, with one of their gunboats, opened fire, and the attack was repulsed, all who had landed being killed or taken prisoners. The reported loss was 4 killed, 19 wounded, and 102 captured. On 26 October Gillmore again opened fire with his heavy guns from Forts Wagner and Gregg, aided by the cross-fire of 150-pound rifles on board the fleet, which completed the ruin of the fort, and all aggressive operations for the season against Charleston ended, although a desultory fire was kept up against Sumter during November and December to prevent the remounting of guns. The casualties in the fort from 12 Aug. to 11 Dec. 1863 were 43 killed and 165 wounded. From a tabular statement prepared by an officer in the fort it appears that, from 12 Aug. to 31 Dec. 1863, 26,867 shot were fired at it, 19,808 falling against or into it. On the approach of Sherman's army the fort was evacuated 17 Feb. 1865, and 14 April following the same flag that Anderson lowered in 1861 was raised over it with imposing ceremonies. Consult: 'Official Records,' Vols. I.–XXVIII.; Doubleday, 'Reminiscences of Forts Sumter and Moultrie'; Crawford, 'Genesis of the Civil War'; Gillmore, 'Engineer and Military Operations Against Charleston in 1863'; The Century Company's 'Battles and Leaders of the Civil War,' Vols. I. and IV.; 'Naval War Records,' Vol. XIV.

E. A. CARMAN.

Fort Tot'ten, N. Y., a United States military post, established in 1862 at Willett's Point, on Long Island Sound, near Whitestone.

Fort Wadsworth, wŏdz'wọrth, N. Y., a United States military post on Staten Island, at The Narrows, in New York Bay. It was established in 1827, and was first called Fort Richmond.

Fort Wagner, a work constructed by the Confederates near the north end of Morris Island, a low, narrow, sandy strip of land, about

3½ miles in length, on the south side of Charleston harbor. It was 2,600 yards directly south of Fort Sumter, to which it was an outpost, and was constructed to hold and control all that portion of the island upon which effective breaching-batteries against Fort Sumter could be established. On the northern end of the Island was Fort Gregg, and the southern end was held by a small force of infantry and artillery. Preparatory to a combined naval and land attack on Fort Sumter and Charleston, it was determined to reduce Fort Wagner and take possession of the entire length of Morris Island, and Gen. Gillmore, an engineer officer of skill, was selected to command the land forces. On 10 July 1863, Gillmore, who had concentrated 6,500 men and secretly placed 47 siege guns and field guns in position on the extreme northern end of Folly Island, attacked the Confederate position on the south end of Morris Island, effected a landing, carried the Confederate batteries of 11 guns, and by 9 A.M. occupied three fourths of the island and pushed his skirmishers to within 600 yards of Fort Wagner. The navy assisted with four ironclads. At daylight of the 11th an attempt was made to carry the fort by assault, which failed, with a Union loss of 172 killed and wounded, and 119 taken prisoners, of whom 40 were wounded. The Confederate loss was 12 killed and wounded. After this failure counter-batteries were established against the fort, and it was determined to attempt, with the aid of the ironclads, to dismount its guns, and either drive the Confederates from it, or open the way to a successful assault. The navy kept up an almost incessant fire upon it, and the land batteries were established at distances ranging from 1,330 to 1,920 yards of it. Soon after midday of the 18th the navy and 41 light guns and siege-mortars opened a furious fire upon the fort, which was continued until nearly all its guns were silenced and its defenders driven into bomb-proofs, when about sunset, after 900 shot and shell had been discharged, Gen. G. C. Strong's brigade of six small regiments, supported by Col. H. S. Putnam's brigade of four regiments, made an assault. As the head of the column left the trenches the guns of Forts Wagner, Gregg, and Sumter opened on it, and as it neared Fort Wagner the Confederates mounted the parapet and poured in such a destructive fire of musketry that the leading brigade was repulsed; but the supporting brigade gained a foothold, which it kept for over an hour, when it was driven back. The Union loss in this second assault was 1,128 killed and wounded, and 389 missing; among the killed or mortally wounded being Gen. Strong and Col. Putnam, John L. Chatfield, and Robert G. Shaw (q.v.). The Confederate loss was 56 killed and 133 wounded.

Gillmore now turned his attention to Fort Sumter (q.v.), which, with the aid of the navy was, by 23 August, reduced to a shapeless mass with almost every gun dismounted or silenced. Meanwhile regular approaches were made against Fort Wagner, thousands of heavy shells were thrown against and into it, and by 26 August the trenches were within 250 yards of it, the intervening space being a flat ridge of sand, scarcely 25 yards wide, and for a great part planted with torpedoes. The Confederates were driven from position behind this flat ridge and the approaches continued until within a few yards of the fort, when the heavy guns of the army and navy opened on it. Final operations were inaugurated 5 September at daylight, and in 42 consecutive hours 17 siege guns discharged 1,411 shells at the work, 1,247 of which struck it, the ironclad New Ironsides joined in the attack, the fort was silenced, over 100 of the garrison killed and wounded, and an assault was ordered for the 7th. When morning came the fort had been abandoned and its garrison, with that of Fort Gregg, had escaped, leaving the entire island with the 25 guns of the two works in Union possession. The Union loss on Morris Island (10 July–7 September) was 381 killed, 1,372 wounded, and 565 missing, an aggregate of 2,318; the Confederate loss was 157 killed, 674 wounded, and 238 missing, an aggregate of 1,069. Consult: 'Official Records,' Vol. XXVIII.; Gillmore, 'Engineer and Artillery Operations Against Charleston, 1863'; The Century Company's 'Battles and Leaders of the Civil War,' Vol. IV.

E. A. Carman.

Fort Wal'la Wal'la, Wash., a United States military post, established in 1857, at Walla Walla.

Fort War'ren, Mass., a United States military post on Georges Island, near Boston, established in 1837. During the Civil War it was used as a military prison.

Fort Washington, Md., a United States military post on the Potomac River, near Washington, D. C. It was established in 1815 as Fort Warburton.

Fort Washington, N. Y., the site of a former fort at 182d Street, New York, overlooking the Hudson River. It was built prior to the Revolution and surrendered to the British under Sir William Howe (q.v.) 16 Nov. 1776, after a terrific engagement. The loss of the fort caused consternation throughout the United States. Consult: De Lancey, 'The Capture of Fort Washington' (1877).

Fort Wayne, Ind., city and county-seat of Allen County. Situated in the northeastern part of the state, 102 miles northeast of Indianapolis, upon the Saint Joseph, Saint Mary's and Maumee rivers, confluence of the first two within the city's limits forming the last named. It is notable as a railway center, the following lines passing through or terminating there: Pittsburg, Fort Wayne & Chicago, of the Pennsylvania Railway system; Wabash; New York, Chicago & St. Louis; Grand Rapids & Indiana; Cincinnati, Richmond & Fort Wayne; Lake Shore & Michigan Southern; Fort Wayne, Cincinnati & Louisville; Cincinnati, Hamilton & Dayton. The city is central in a rich and highly developed agricultural region that produces abundant crops of the cereals of temperate climates. Considerable tracts of hardwood timber yet remain in what once was one of the most richly wooded sections of the northwest.

Manufactures.— These cover a wide range and embrace numerous establishments of large magnitude. In the various industries about 10,000 operatives are employed. The manufactures include carwheels, Corliss and other steam engines, boilers, gas engines, gas machinery, iron and steel bars, freight and passenger cars, locomotives, electrical machinery and electrical fittings and fixtures, hosiery.

gloves, caps, oil tanks, organs and pianos, women's garments, road construction machinery, carriages, wagons, washing machines, furniture, paper boxes, lumber, sash, doors, malt liquors, cigars, harness and leather findings and a considerable variety otherwise of products in iron and steel, wood and textile fabrics. The value of the manufactured products is about $15,000,000.

Municipal Service and Improvements.— The municipality owns and operates the public waterworks system, an abundant supply of pure water being procured from wells bored deeply into the rock, and distributed by means of two thoroughly equipped pumping stations. There is a handsome and substantial city hall and police headquarters and eight modern and thoroughly equipped houses advantageously situated shelter the city fire department. The public buildings in the city are a court-house (county), completed in 1902 at a cost of $1,000,000; United States post-office and court-house; a public library erected at a cost of $100,000 through a donation by Mr. Andrew Carnegie; county jail; high school and manual training school building, completed 1904 at a cost of $300,000, and 15 grammar and ward school buildings, most of which are of very modern construction and beautiful architecture.

Schools and Colleges.— The free-school system maintained by the city embraces a high school and manual training school, a training school for teachers, and 15 ward and grammar schools, together with kindergarten departments. The free-school system is governed by a board of three trustees, elected triennially by the city council, the immediate executive head of the schools being a superintendent elected by the board. There are 6 Roman Catholic parish schools in addition to a high school for boys and an academy for girls; and 6 German Lutheran parochial schools. Concordia College, founded in 1850, is seated in Fort Wayne, and is maintained under auspices of the German Lutheran church. Near the city is an academy maintained under auspices of Catholic sisters, an academy for the higher education of young women. Among other institutions of learning are a college of medicine and surgery, a conservatory of music, a school of art, two business colleges, and a school of oratory, expression and physical culture.

Churches and Charities.— There are 47 religious congregations and 40 church edifices, many of them beautiful and costly examples of ecclesiastical architecture. The congregations are distributed denominationally as follows: Baptist, 2; Christian, 3; Congregational, 2; Episcopal, 2; Evangelical Association, 1; Evangelical Lutheran (English), 3; Evangelical Lutheran (German), 4; German Lutheran, 3; Methodist Episcopal, 5; Free Methodist, 1; African Methodist Episcopal, 1; Presbyterian, 4; United Presbyterian, 1; Reformed (German), 2; Roman Catholic, 7; United Brethren, 1; Baptist Brethren, 1; Christian Science, 2. The city is the see of the Catholic Diocese of Fort Wayne. The city has a central charities organization and many of the religious congregations maintain comprehensive societies for charitable and benevolent work.

Hospitals and Asylums.— There are 4 large hospitals of modern equipment, 1 non-sectarian, 2 under Roman Catholic and 1 under German Lutheran administration. There are 3 orphan asylums, two sectarian and 1 maintained by the county; home for emergencies and a refuge for women. Just beyond the city limits is the State School and Home for Feeble-Minded Youth of both sexes and home for epileptic women.

Finance.— The net public debt of Fort Wayne was $560,800 in 1910, and the assessed value of all taxable property was $32,500,000, which was 50 per cent of the actual value. The tax rate was $1.08. The amount of exchanges of the Fort Wayne clearing house for the year ending 30 September 1910 was $51,757,200. The city has many national and private banks, trust companies, and building and loan associations. Its banks represent a capitalization of about $5,000,000.

Parks and Cemeteries.— The total public park acreage of the city is 95.49, distributed as follows: Swinney, 45.24; Lawton, 31.20; Reservoir, 13; McCulloch, 4; Hayden, 1.12; Piqua, .75; Old Fort (site of stockade built by General Anthony Wayne in 1794), .18. There are 5 cemeteries — Achduth Veshalom (Hebrew), Concordia (German Lutheran), St. John's (German Lutheran), New Catholic (Roman Catholic), and Lindenwood (non-denominational).

Government.— The city is governed under a special charter, conferred by the state legislature, which provides for a municipal legislative body of two councilmen from each of the ten wards, chosen biennially, a mayor and city clerk, chosen quadriennially, and a board of waterworks' trustees, chosen biennially. The board of public works, board of public safety, health commissioner and park and street superintendents and city attorney and city comptroller are appointed by the mayor. Council fixes all municipal tax levies and appropriations and has final approval of all contracts and franchises.

Trade and Commerce.— Fort Wayne is an important and flourishing trade centre and has a commerce that embraces extensive wholesale and jobbing operations in dry goods, groceries, light and heavy hardware, drugs, millinery, paper, etc. The total volume of wholesale trade has a value of about $10,000,000. The total post-office receipts are about $200,000 annually.

History.— The city takes its name from a fort built on a part of the present site of the city by General Anthony Wayne in 1794. The place, however, had a history that long antedated this. There is evidence that La Salle had visited the locality as early as 1670. It was the site of Ke-ki-on-ga, the "Central City" of the once powerful and warlike Miami Indians. At different times during the seventeenth and eighteenth centuries French and English had military posts at Ke-ki-on-ga. In 1790 General Harmer led an expedition against the Miami City, but was signally defeated in a fierce engagement on the Maumee River within what is now the limits of the city of Fort Wayne. In 1791 General St. Clair in a similar expedition was overwhelmed a short distance southeast of Fort Wayne by the Indians under the famous Miami Chief, Little Turtle. General Anthony in 1794 headed a third expedition against the Indians in the Northwest and after utterly defeating them at the battle of Fallen Timbers on the Lower Maumee in Northwestern Ohio, marched to Ke-ki-on-ga and in September of that year built his stockade on an eminence overlooking the confluence of the St. Joseph and St. Mary's rivers. These was no further serious trouble within the Indians until August 1812, when the conspiracy of Tecumseh and his brother The Prophet ensued in a close investment of Fort Wayne and its meagre garrison. The siege was vigorously pressed for about two weeks, when it was raised by a force that had been dispatched to relief of the beleaguered garrison. Fort Wayne at once assumed importance as a trading post and in 1825 the town itself was laid out. In 1840 Fort Wayne took rank as a city. Between 1850 and 1860 began the era of railroads, when growth received fresh and powerful impetus and Fort Wayne came to be one of the foremost industrial and commercial cities of the State. Pop. (1900) 45,115; (1910) 63,933.

Harry M. Williams,
Managing Editor Fort Wayne 'Sentinel.'

Fort William, a Canadian City at the head of Lake Superior, founded by the Hudson Bay Company in 1805; incorporated a town, 1892; a city, 1907. The harbor comprises Thunder Bay, Kaministiquia River and its branches, the Mission and McKellar Rivers, with a depth of 26 feet. The gateway to the granary of the British Empire, there are here 13 elevators with a capacity of 21,000,000 bushels; also large coal and freight docks, a car-wheel, water pipe, and stove foundry, flour mills, hard and soft wood factories, and machine shops. It is the Lake and rail terminus of the Canadian Pacific, Grand Trunk, and part of the Canadian Northern Railways. It is the largest shipping port in the Dominion excepting Montreal. Its water supply is brought from a mountain lake by gravity; it owns water works, electric light, telephone and street railway systems, and has an abundance of cheap water power for manufacturing purposes. Pop. (1901) 3633; (1910) 25,000.

James Murphy,
President of Fort William Board of Trade.

Fort Worth, Texas, city, county-seat of Tarrant County; on Trinity River, and on the Fort Worth & D., the Fort Worth & R. G., the Gulf, C. and S. F., the Chicago, R. I. & P., the Texas & P., the Missouri, K. & T., Houston & T. C., International & G. N., Saint Louis & S. W., and Red River, T. & S. R.R.'s; about 32 miles west of Dallas. It was organized as a town, under general State law, in 1873, with a population of 1,100; and chartered as city in 1882, with a population of 11,285. The government is vested in and administered by a mayor, nine aldermen, city marshal and assessor, and tax collector, elected by popular vote; city secretary, auditor, treasurer, superintendent of waterworks, chief of fire department, street commissioner, and other subordinate officials elected by the city council. The city owns and operates the waterworks and the street-lighting plant. The city-hall and fire halls are commodious structures of stone and brick. It has over 80 miles of improved streets; 68 miles of sewers, and nearly 100 miles of pipes. There are eight national banks and two trust companies and savings banks, with a capital and surplus of $2,965,352, and deposits amounting to $7,928,577. Fort Worth is the centre of the cattle interests and grocery trade of the State, and of the grain and milling interests of the northwestern portion of the State. Having 11 trunk lines of railway with 16 outlets, it is the greatest distributing point of the Southwest. The flour mills, breweries, packing houses, and foundry and machine works are the principal industrial enterprises of the city. The county court-house is constructed of granite and marble from the Texas quarries. The passenger station is one of the largest and finest in the country in a town of this size. The banking houses, colleges, medical schools, high-school building are costly and imposing structures. Fort Worth has one high-school building, 11 ward school buildings, Fort Worth University, Polytechnic College, Medical School, Saint Ignatius Academy, and the public free library. There are 42 church buildings, representing all denominations. There are also sanitariums, a free kindergarten, Rescue Home, a local Benevolent Home for Children, the Saint Joseph's Infirmary, and the State Masonic Widows' and Orphans' Home. There is one public park of 50 acres, several small parks, and three cemeteries.

The growth of population has been rapid but not unhealthful. The vital statistics show less than nine deaths to 1,000 for a series of years. There are no local causes for disease. It is nearly 700 feet above sea-level, and is fanned by cooling gulf breezes during the summer, making a pleasant and healthful place of residence. Pop. (1890) 23,076; (1900) 26,688; (1910) 73,312.

B. B. Paddock,
Fort Worth, Texas.

Forth, fôrth, a river of Scotland, rising on the east side of Ben Lomond, in Sterlingshire.

Forth Bridge, The. See Bridge.

Fortifications («to fortify,» precisely following its Latin derivative, is *facere fortis*, «to make strong»), such artificial positions as are required for military use. Primarily, such positions are for defense; but no less important in operations against defensive works already established by an enemy. Two definitions, used in another connection, but officially approved by the late Col. Edward Bruce Hamley, president of the Queen's Staff College, London; by the late William T. Sherman, general of the American army, and by the late Theodore D. Woolsey, president of Yale University, indicate the drift of the subject-matter under immediate notice.

1. «Military Science,» the mother of all such constructive relations, «while that of force, as in all police or other protective law, is founded upon the adaptation of all possible means to meet an impending crisis. The wisdom of the statesmen differs only in degree from that of the ordinary householder, and both alike aim at a wise constraint of offensive elements and the radication of such as are adapted to that end. Hence, to meet the demand adequately, wisely, and successfully, thereby to secure ultimate public safety, is the expressive logic for personal action, municipal action, and military action. The brain-power is banded to various shaftings, and the mental processes differ by virtue of different adaptations, but the prime activities are

the same.» The citizen who is to be protected, equally with the technical expert, should be sufficiently interested to become actively sympathetic in whatever relates to the national defense.

2. «Military engineering,» as the second preliminary definition, «is the application of mathematics and mechanics to the maintenance, or the reduction of fortified positions, the interposition, or the removal of artificial obstacles to the passage of an army, and the erection of suitable works for the protection of territory or troops.» Rival systems of practical military engineering, stimulated by successive inventions, have so multiplied their technical terms, borrowed from many languages as well as from their authors, or local customs, that the ordinary citizen who desires but a suggestive history of that progress would be compelled to have both lexicon and scientific text-book by his side in order to fathom their mysteries.

The origin of artificial defense and the development of primitive types until isolated families or groups of families gradually crystallized into independent and self-supporting nations, are so familiar to the willing reader of general history as to need but brief mention. The defense of the retired domicile from wild beasts and the forays of irresponsible robbers was as distinctly a matter of prime necessity for the head of a family, as for the tiger, the wolf, or the robber, to find in thicket, cave, or mountain fastness, his own protection from pursuit and punishment. The simplicity of weapons of offense and defense harmonized with the demand for artificial protection against violence of every kind. The bow-and-arrow and javelin, with the sling, for long range; and the knife, sword, club, and battle-ax, of stone or metal, for hand-to-hand conflict, required protection from each. The hide-bound protective shield at first, and later, the more impenetrable metallic armor, were but types of the development which gradually evolved the fortification proper, in proportion as weapons enlarged their range of stroke as well as their destructive effect. The shield was, in fact, both the simplest as well as the true prototype of defense against superior force. Under its cover, one man could hold several antagonists at bay. When flanking assailants neutralized its protective value, men, in groups, enlarged its functions, until, by the hollow square, or the solid mass, a phalanx could withstand the onset of many times their number. Their uplifted shields were like a modern bombproof against falling flights of arrows while the men, thus protected, supplied constant reinforcements for those in front who were disabled by ax, sword-thrust, or javelin.

Social Conditions.— The sanctity of the home-domicile was, from earliest times, the basis of its protective and stubborn defense. The Hebrew, the Chaldæan and Egyptian traditions and records, as well as those of Greece and Rome, still later, perpetuated that philosophy; and the ancient German, Goth, Moor, and Briton, through all their feudal, racial, and political rivalries, alike honored precepts thus coincident with the first groupings of families for a common defense.

The «Home, as a Castle,» was not merely of British conception, but a vital factor in human happiness and safety. With the gradual accumulation of both numbers and wealth, the protection of the many became the duty of each individual, and the assertal of tribal or national superiority, on the part of the more numerous and powerful, engendered such competitive conflicts that centres of influence exacted more systematic and elaborate national defenses. Excursions against other states, and responsive invasions, were the means employed by ambitious rivals to increase their territorial domain and subject inferior peoples to their dominating control.

By this complex evolution of warring peoples, led by daring spirits, systems of more speedy intercommunication, transportation, and the accumulation of war material, arms and food included, became indispensable to the public safety, until warehouses, detached strongholds, internal citadels, and organized armies were the result. All draft animals and beasts of burden were utilized for attack or defense, so that the horse of the warrior might, in turn, drag the war chariot with its out-reaching scythe blade; and both camel and elephant carried miniature castles upon their backs for archers and spearsmen, mounted above.

Military Conditions.— The fundamental principle in all substantial fortifications has been the effort to ensure a destructive fire upon every available avenue of approach to the place protected, and, with this, to secure such enfilading and cross-fire that no position remained unprotected. Human competition has ever been the same in essence, and where no reliable historic record responds to inquiry, exhumed ruins, memorial tablets, and deciphered hieroglyphics, solve all doubt as to the proposition that military science and military engineering belonged to all human activity, ever the same in principle, and differing only in application and development. The paramount object was, to eliminate disparity in physical strength and enable the few to resist the many. Personal combat at short range came to a limit as people gathered in cities; and breastworks first, and then solid walls, became essential in proportion as the numbers of non-combatants gathered there for shelter and safety.

Illustrations.— The most primitive forms of which the earth retains an outline were oval, or circular, mounds or entrenchments, even before walled towns were constructed, these being more compact for defense of each front, or exposure, by defenders from the centre. More modern defenses, especially against savages, of the block-house type, had this peculiar value, and even women could prepare arrows, or load weapons, for defenders who in turn acted in all directions.

Such defenses were upon commanding positions, to guard against surprise, with wood and water always within easy reach. These were transient, and usually against predatory or nomadic peoples, of no greatly superior strength. As populous centres increased, defenses were of stone or brick walls of such height and breadth that large armies could mount their summits and chariots convey men and munitions from one point of defense to another. These were surrounded by a flooded moat, or ditch, and were easily made impregnable against an army of equal force and equipment. Towers at angles of quadrangular defenses, and to protect gates of entrance, exit, or for sallies upon an enemy, were supplied with lifting or drawbridges, and mines and tunnels were excavated under the ditch itself for more ready surprise of a careless adversary. Cæsar describes a mine which he advanced beneath both ditch and wall, supporting the wall with timber until he could fill the shaft with dry branches, and upon setting all on fire, the wall crumbled, and he stormed the breach.

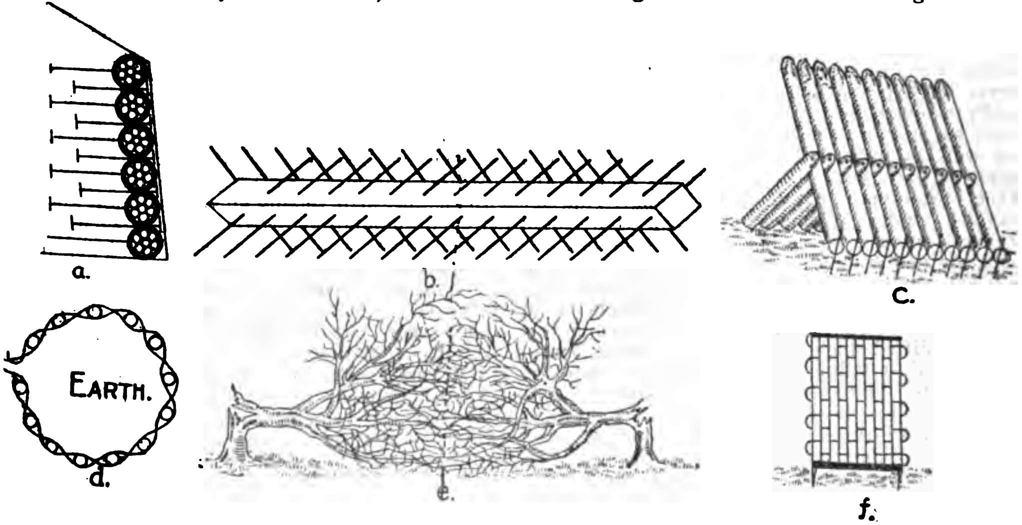
Great machines were made by which to reach engirdling camps, or crush assailants who attempted to bridge, or fill the ditch, and thus gain access to the wall summit by scaling ladders, when unable to force the gates. The catapult and ballista were two of these, which, on the principle of the spring-board and sling, and the increased length of its vibrating arm, the radius of its centrifugal force, would hurl heavy stones at a great distance and send blazing balls of tallow, or pitch, congreve-rocket-like, to destroy a hostile camp.

To meet these mighty forces, corresponding engines of swinging, battering timbers, called «rams» from the device curiously shaped in front, would strike a blow equal to the force of a 30-pound shot, powder-driven. Movable towers, protected by wet hides from fire, were advanced, putting its archers upon a level with those upon the city wall. Titus, at the siege of Jerusalem, brought such towers sufficiently near that, with grouped lances and timbers, he bridged the intervening distance and fought on the city wall itself.

With the increase of territorial domain, subordinate but correlated military engineering had its special province. Territorial boundaries, mountain passes, sharp defiles, river fords, and watercourses, had to be guarded by detached outworks, and these must have close relation, each to the next in order. Swamps, impervious to mounted or heavily armored men, were utilized, and their narrow approaches, or shallow portions, were so fashioned and guarded as to keep assailants from fire-range upon defenders. Outlying summits were made signal stations, both against herds of wild beasts, which in early times were as dangerous to flocks and herds as robbers or hostile invaders were to the inhabitants themselves. Bonfires and flaming torches, as well as a chain of vocal and flag-shaking sentries, became adjuncts to a better external defense. Cæsar had «soldiers who shouted to each other until the alarm reached his camp, through a great distance.» The ancient Persians, and later the Scotch and Swiss, were noted for this signal service, but no experience of the kind has such memorial emphasis as that described by the Hebrew prophet Isaiah, who saw in the system of his own people the forecast of a distant future, when «the watchman, from peak to peak, should see eye to eye, and together lift up the voice» in jubilant rejoicing over universal peace to be proclaimed the world around.

Before treating upon fortifications proper, within the limits of this article, there are subsidiary defenses, pro and con, which have antiquity for their use, and the latest of modern battlefields for their equally advantageous application to-day. Their names are familiar as household words, and yet are generally treated as simple types of barbarous usage, before firearms and the sphere of smokeless powder and electricity alike defied stone and iron defenses, and sent destructive missiles beyond human aim and human sight. A few plain illustrations indicate many which had effective use during the American Civil War of 1861–5.

The diagram includes the following:



(*a*) A parapet forming the front of a modern fort, with fascines, behind which earth is packed as they rise, one upon the other, and are locked into the trampled or rammed earth by hoop-poles or common sticks, the fascine being but a bundle of sticks, hooped, or tied with chain or rope.

(*b*) The Chevaux-de-frise, an iron cylinder, or a trunk of a tree, filled with spikes of iron or wood, to which, in case of wood, sword blades, and bayonets may be applied.

(*c*) Inclined and sharpened posts, really an inclined palisade, or stockade material, fastened to the earth, and its parts fastened together by chains or ropes.

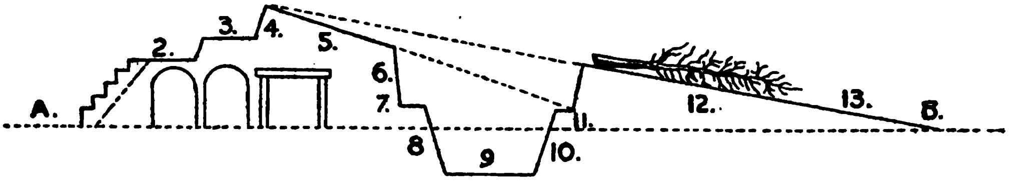
(*d*) A basket, open at both ends, made by inserting stakes in the ground in a circle, braiding them by willow, or other flexible green wood, and when filled with earth, forming material for building a parapet, or strengthening a low breastwork.

(*e*) A sample of felled trees, across roads, creeks, ravines, and obstructive to approach by horse or foot.

(*f*) A species of hurdles, when horizontal sticks, or poles, vertical or horizontal, are interlaced by willow, brush, or modern wire (as in Cuba), making a fence of stout resistance, and holding assailants under deadly fire.

The farmer's common harrow also was utilized extensively.

All these "obstacles" have been utilized in filling a surrounding ditch to prepare the way for storming the fort itself. Only old soldiers who participated in the American Civil War, or the Spanish war, can realize the extent of their use in actual service, and Cæsar himself, when establishing winter quarters, writes: "Having cut young trees and bent them, by means of their numerous branches extending on the sides, and the quick briars springing up between them, made these hedges present a fortification like a wall, through which it was not only impossible to pass, but even to penetrate with the eye." It will be noticed, later, that at the battle of Franklin, Tenn., during the Civil War, prickly osage-orange was a material factor in a successful defense.



A.—B. Level of parade ground, occupied by buildings and by bomb-proof magazine and hospital, so far as the same are not included in chambers beneath the parapet.

(1) The interior slope of the parapet, on a slight incline for easy ascent, or with steps, and these broken at intervals for entrance to chambers beneath.

(2) Level ground, or platform (*terre-plein*), for troops supporting guns.

(3) A step (*banquette*) for gun.

(4) Parapet.

(5) Exterior slope of parapet.

(6) A facing of wood, or masonry, or of *fascines* linked into the earth as it is built (see OBSTACLES, *a*), to hold the parapet in place, and called the *revetment*.

(7) A narrow shelf, path, or *berme*, between parapet and ditch.

(8) The side of ditch next to parapet, *scarped* down at an angle, and therefore called the *scarp* or *escarp*.

(9) The ditch itself, and faced with masonry in permanent works.

(10) The opposite side of the ditch, and therefore called the *counter-scarp*.

(11) A path, or border (*berme*), commanded by rifles from the parapet and used for defending the interior slope of the *glacis*, and for sallies through openings outward, or beneath, and called the *covered way*.

(12) The superior slope of the covered way, called the *glacis* because of its smooth descent to the general surface without the fort.

(13) *Abattis*, felled trees, with shortened and sharpened branches, directed outward, with the butt securely fastened at head of the *glacis*.

Fortifications Proper.— Impregnable fortresses no longer exist. All along the trend of history the term has been fanciful and merely relative. Even Gibraltar, as an isolated fortress, aside from its political and moral force, has its military value as a well located rendezvous for troops and shipping, and the theoretical guardian of the passage from the Atlantic to the Mediterranean Sea. Of this passage, it has no supreme control, without a sufficient naval contingent. In all other respects, it simply defends itself, with no interior at its back, and when without control of the sea, by fleets, imprisons a valuable garrison. In modern times the stationary must yield to the mobile. The art of destruction is more potent and far-reaching than the skill of man to preserve his own workmanship.

Reference has been made to towers, as well as walls, and even after the invention of gunpowder, systems of defense, as well as isolated forts, had their progressive development, in which the United States followed European antecedents and the progressive systems of one general type until the Crimean war largely revolutionized modern practice. A single profile of a cross-section of defenses, as matured during more than two centuries, is sufficient for this article, with an accompanying sketch of the bastion system, which must under no conditions be neglected in any defense against a superior force.

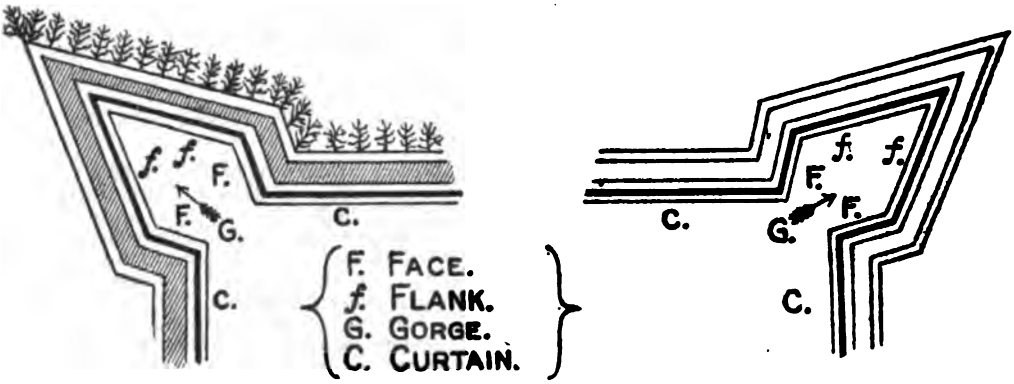
The Bastion.— The *profile* thus noticed obtains throughout the fort, even when it assumes other forms than that of the simple quadrangle. The *pentagon* and *hexagon* have generally been used, leaving to the province of a simple *redoubt* the simpler outline of defense. Very early *projections* were *built out* from these fortified positions, at their angles, hence their name, *bastion*, to give a wider range of *outward* fire, as well as a more direct *flanking* fire, along the walls covered by these projections. These walls were called *curtains*. The containing lines of the salient angle were called *faces*, and the lines connecting the faces with the main wall were properly called *flanks*.

Before these curtains, or main walls, minor defenses were added, whether *ravelin* or *teneille*, and these might be again covered by ditch and glacis, subordinate to but protected by the superior fire from the main position. A diagram of the simple bastion, similar to those in use around Washington in 1861–5, and common to all modern works, is added.

Inland Positions.— Isolated defensive positions of inferior type have been sufficiently noticed. Their history is common to every mature reader. Transient and movable defenses will be noticed in connection with army movements, although earth defenses already partake of the character once referable only to walls of solid masonry. As against a foreign enemy, the United States has more need of coast defenses than many other nations, as her commercial centres are largely upon the sea; but, as a nation, her capital may be classed with those of other countries, which look to frontier defenses for a substantial protection against foreign attack. But forts, on a frontier, may be ignored, *turned*, *left in the rear*, as when Paris was taken, while idle thousands of her defenders were lost to the national defense. Hence isolated capitals and commercial inland cities must have detached, but closely related outer defenses, beyond the reach of immediate assault or bombardment by an invading enemy.

During the American Civil War, when internal forces attempted the capital, the city of Washington furnished the best type of a city so assailed; 43 forts and batteries, and 36 additional batteries, mounted 99 rifled cannon in *embrasures* and 25 *in-barbette,* as well as 113 smooth-bore in *embrasures* and 147 *in-barbette,* making a total of 384 guns. But additional platforms were erected and made ready, so that a total of 743 guns could confront any new phases of attack. By direction of Gen. Scott, then in command, the writer was directed to visit all these works during their establishment, and at the time opposing forces were displaying their flag upon Munson Heights, within view from the outer works. The *cordon* of forts, batteries, stockades, block-houses, redans, and bridge-heads was complete.

Sea Coast Positions.— Sea coast defenses, from earliest times, have been of massive masonry. Many that still frown innocently upon the American coast, between Boston and New Orleans, are chiefly monumental of obsolete defenses against hostile fleets. Two or three tiers of guns, in as many series of arched chambers, called *casemates,* with a fourth row mounted upon the exposed parapet, or rampart, were expected to cope successfully with the old 120-gun ship-of-the-line. Fort Moultrie, in rude form, in 1776, withstood resistance, with log ramparts, better than with later ones of stone, as in 1861, when sand bags were introduced to support its powers of resistance.



CLASSIFIED DEFENSES.

Modern guns, supplied with new explosives, shatter the hardest rock and splinter the toughest timber. The earth alone, and especially sand, will disarm the penetrating projectile of the present day. A single illustration harmonizes with the advent of the new system. Upon the trial of the first 81-ton gun, built at the Woolwich Machine Shops, near London, a mound of sand was erected on the proving grounds against the Thames embankment. Six times a bolt of 1,300 pounds was fired, increasing the powder-charge from 170 to nearly 300 pounds. When the last bolt was dug from the butt, it had entered but 47 feet, 5 feet under the surface of the sand.

Standard tables have long been under consideration to indicate the comparative resistance of earths and gravel, but in all cases, sand, which quickly closes upon what it receives, has been the most obdurate to defy deep penetration. And now, upon the British as well as the American coast, modest mounds or piles of sand present a very indistinguishable target, while, to the nearer view, the abundance of wild grass, daisies, buttercups, and tansy, is its only relieving feature. And yet behind each sand pile, in separate sections, each for a single gun, is to be found the most formidable land defense of modern times. The former «42-pounder» of the casemate and the main battery of a ship-of-the-line, and weighing but 8,750 pounds, is replaced by a gun 40 feet in length, weighing 58 tons, and capable of sending a shot of more than one half a ton, charged by 475 pounds of powder, nearly or quite 7 miles, once each 3 minutes.

A quick release drops the gun below the parapet for reloading. Each battery, however many guns may fall within its control, is operated at will, as if but a single piece were in position. A revetment of solid masonry holds the sand piles in position, and beneath the gun-carriages, which are exposed to the weather, are the necessary passages which communicate with all sections of the battery. Magazines and tackling for handling shot and shell are also under bomb-proof cover, and both placement and independent action of each piece are complete. At suitable distance, but within a practical community of range through adjustable range-finders, sand «pits» for mortars are located. Each mortar revolves upon its own platform, and groups of fours, in closely related pits, can be handled, through signal communication, in connection with the heavy gun batteries, and command a joint delivery of fire upon the same hostile force. As with the gun placements, each mortar pit is independent, in magazine and other appliances, for efficient service.

Floating Batteries.— The battleship as well as the stone fort has also changed character, and become a floating steel fortress. An encircling squadron, in concave formation, can concentrate a weight of metal upon an exposed land defense that cannot be returned by a full equivalent. Other floating batteries, the peer of any, must intervene in support of the land defense, with auxiliary «torpedo boats» and «destroyers.» The contingency of landings to take open batteries, in their rear, is increased by swift steam transportation, and the gravity of defense is more serious in proportion as a nation, having a large coast to defend, has distant, dependent territory, equally demanding a mobile naval force for its defense. The submarine boat, the dirigible balloon, and wireless telegraphy, menace modern commercial ports with visitations only less fatal than those of the earthquake and volcano.

Field Fortifications.— This branch of military engineering has a duplex character, but of quite uniform general requisites. They may either constitute the chief defense of a city, or neutralize the numerical superiority of an enemy in the field by wise adjustment of their lines. Two illustrations are suggestive of their value:

On 5 April 1862, when both officers and men were alike inexperiened in operations of war, between large armies and over extended territory, remote from their general base, the Federal army was confronted at Pittsburg Landing, Tenn., by a largely superior force under command of Gen. Albert Sydney Johnson, of the Confederate army. Skirmishing occurred during the day; but Gen. Grant, the chief Federal commander, believing, as he advised his superior, Gen. Halleck, and states in his 'Memoirs,' that there was hardly the slightest possibility of attack, as reinforcements were on the way to his support, failed to entrench. On the following morning, an attack was made in force, driving the Federal army back to the Tennessee River, where the arrival of Gen. Buel's division alone averted a serious disaster. Neither Gen. Grant nor Gen. Sherman committed a similar error of judgment later in the war.

On 30 Nov. 1864 Major-Gen. John M. Schofield retired from Pulaski, closely followed by the two-fold superior army of Gen. Hood. After fighting daily for three weeks, and after frequent rains, leaving with night he marched directly to the city of Franklin, Tenn., where in the bend of the Harpeth River, he gave battle. Between morning and 3 o'clock of that afternoon, when the combined Confederate divisions made an impetuous assault, his wearied soldiers had so utilized the shovel, pick, fence-rails, locust trees, and osage-orange hedges that, behind their shelter, he repulsed the assault, inflicted a loss of nearly 7,000 men upon his adversary, including 12 general officers, in killed, wounded and captured, and safely fell back upon Gen. Thomas, at Nashville, with a loss of but 20 wagons and less than half the casualties of his opponent.

Similar entrenchments had their ancient types in those of Cæsar, who invariably established his camp within a quadrangle surrounded by a rampart of the height of from 7 to 9 feet, with gates on four sides, and sufficiently large in area to include all animals and supplies belonging to his command. On one occasion, seeking winter quarters, he carried a parapet, with ditch, 16 miles, from Lake Geneva to Mount Jura, 15 feet high, and with various small redoubts on the line, so that practically he multiplied his numerical strength three-fold. In modern times, the Crimean war introduced a system of earthworks which withstood a heavy fire before which granite walls had crumbled.

Reduction of Fortified Positions.— Field works, against a fortified position, assume an attitude of counter-defense, as well as a cover for siege or assault. The relative strength of the assailing force belongs to another branch of the military art; but it must be proportionately greater, as the circumference of the investment enlarges, and must prove able, at any vital point, to meet any sally of the garrison, either by numerical superiority, or its equivalent, in artificial defense. Inequalities of the ground, commanding summits, a safe communication with the base of supply, are *strategic* conditions; but all are parts of the position to be assured. After estimating accurately the intervening distance, and at what nearer approach the encircling ditch may be filled, or bridged, for assault, the advance begins. A mortar battery in the rear, or guns in an elevated position, may play upon the intervening space to protect the *pioneers* in locating rifle-pits, while establishing the *first line* of works. The general advance, as thus initiated, is that of a ship beating against the wind, and the zig-zag course adopted borrows its name, *traverse,* from marine usage. Successive files of men dig these traverses, throwing the earth outward to the front, as a cover from fire, and thereby open a way for the advancement of guns, as well as of engineers and troops. A second line, *parallel* with the first, is opened to the right and left, where guns are at once placed in position. A third line, or *parallel,* is so planned as to place the defensive works at the mercy of the besieger. At Yorktown, Va., in 1781, with a river base and no sufficient escape by sea, the effectiveness of the advanced parallel compelled surrender. At Yorktown, in 1862, with works open at the rear for retreat, the scientific soldier in command rightly assumed that the scientific soldier at his front would attempt no assault until his third line was perfected and armed. Hence, he wasted the ammunition of the besieger to the last safe limit, and withdrew his own force in good order, to suit himself.

To this suggestive summary of fortifications, for the unprofessional reader, must be added the statement, that topographical and geographical features largely dominate in matters of attack or defense. *Boundary* lines, whether of mountain or river; interior or coastwise positions; the control of only one or of both banks of a navigable river, give character to defenses and methods for their reduction. Notable illustrations are found in the Dardanelles, the entrance to the Baltic Sea, the Suez Canal, and, prospectively, of vast moment, the Inter-Oceanic Canal in Central America. In proportion as Nature lends her secrets of omnipotent power to the inventive genius of man, so will fortifications change their forms and relations until nations shall control the secret which should inspire all such warlike devices, that of substantial and universal fraternity and peace.

Henry B. Carrington, U. S. A.

Fortifications, Modern Seacoast. The modern science of seacoast fortification wrought marvelous changes during the years intervening from 1893 to 1903. All the great maritime nations expended enormous sums of money to better fortify their coast lines. The United States after 16 years of labor practically completed, during the summer of 1903, the most costly and the most substantial and powerful system of seacoast fortifications in the world. The great improvements made during the latter part of the 19th century in the construction of heavy guns rendered it necessary to revise the system of fortifications formerly in vogue. Iron and steel turrets have taken the place of masonry on exposed sites, where earth cannot be employed to advantage. These turrets are revolving cupolas with spherical roofs, and in most instances even the largest guns are mounted on disappearing carriages. This is essential since the forts are now called upon to prove their prowess against steel-plated warships.

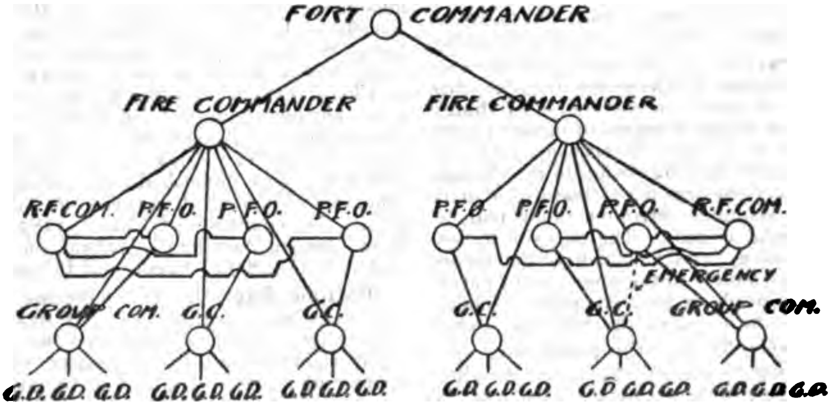
Great Britain concluded the rebuilding of her forts with iron and steel as long ago as 1880, at a cost of $37,000,000 for nine harbors alone. At Dover, England, solid iron turrets of enormous thickness have been built to carry two 80-ton guns to each turret. Steel cupolas of the Gruson pattern to the number of 28 have been constructed since 1890 in various harbors of Germany, Austria, Belgium and Holland. In 1900 the Italian government placed an order for two of these cupolas to mount two 120-ton Krupp guns each, for the defense of the naval station at Spezzia. The order was conditioned on a test shield or segment of the cupola resisting three shots of the Armstrong 100-ton gun — a test which it successfully withstood, though the same gun had pierced every other known form of construction.

The 20th century fortifications of the United States seacoast finished in 1903 are excelled by those of no other nation in the world. The work was outlined if not actually begun in 1886, when a board of military engineers proposed a system of steel turrets, armored casements, barbette batteries, mortar and floating batteries, and submarine mines. So rapid was the advance of military progress that the original plans were largely changed and modified. The vastness of this work and the great cost can be imagined when America has 5,558 miles of seacoast demanding protection of the most improved kind. Between 1886 and 1903, three fourths of the work was finished, and yet huge rifles and mortars to the value of $15,000,000 were required to complete the undertaking. A modern, high-power coast-defense gun is a huge and elaborate machine, the effective management of which requires great skill. A single 12-inch rifle for one of the modern forts cost $45,000, its carriage $41,000, and the emplacement of concrete in which it stands $60,000, or a total initial cost of $146,000. The total expense for each modern fortress amounts to over $2,000,000. The 20th century fortress is not a walled enclosure as of old, but a hole in the ground, or rather a series of holes called emplacements, built of concrete, and each of them containing one or more guns. No lofty, menacing structure strikes the eye of the observer who approaches the works, but instead there is likely to be rolling greensward with shrubbery, suggesting rather the skill of the landscape gardener than that of the military engineer. The real protection consists of 30 feet of iron and masonry and 30 feet of earth, which form a plane sloping outward, so that any projectile striking is promptly buried or glances off harmlessly.

Fort Warren, on Georgies Island, in the harbor of Boston, Mass., which is one of the most notable fortifications in the world, has an armament of 30 guns and mortars. Several of the guns are 12-inch rifles, but the exact character of the armament is kept carefully secret by the military authorities. The mortars are arranged behind the cannon and are capable of throwing explosive shells for a distance of three miles, and with sufficient accuracy to destroy a vessel at that distance. The projectiles carry an enormous charge of maximite which is three times as powerful as gunpowder. Over 600 of these mortars, each of 12-inch calibre, are distributed among the various coast fortifications. They are a vast improvement on the old-style mortars of cast iron with steel hoops. A mortar of the new, modern type is 13 feet long and weighs nearly 30,000 pounds, and requires a charge of 125 pounds to send its conical projectile on its deadly mission. Weapons of this character have not yet undergone a test in actual war. The modern 12-inch rifle is 40 feet long, weighs 104,000 pounds, requires a charge of 520 pounds, and fires a 1,000-pound projectile a distance of 9 miles, with a velocity, upon leaving the muzzle, of 2,100 feet per second. The 12-inch gun could send the same projectile 14 or 15 miles, if the muzzle was sufficiently elevated, but it would be useless in aiming at an enemy who is beyond the limit of vision, for a ship is out of sight only seven miles away owing to the curvature of the earth. These guns shoot three kinds of projectiles. One is the so-called armor-piercing shot, which is nearly solid, having only a small cavity to contain a high explosive. The second is the armor-piercing shell, which has a larger cavity so as to contain more of the explosive. The third is the torpedo shell, which is in effect a torpedo, having thin walls and containing a large bursting charge of maximite. This explosive is a government secret so far as its composition is concerned. Most of the great rifles are mounted upon disappearing carriages, so they are safe from the fire of the enemy except at the very moment of firing. When its fire has been delivered the gun is lowered promptly below the parapet, and after being reloaded is uplifted again to the firing position.

At Fort Wadsworth, on Staten Island, N. Y., at The Narrows, is located another almost perfect system of coast defense, which is regarded by army officers as a model or typical artillery station. The fortification consists of three separate batteries or groups of guns — one battery of five 8-inch guns and two of two 10-inch guns each, a fire commander's station, three position finding stations, a power and electric plant, a storage battery plant of 60 cells for storing of light and power for the stations when the main power plant is not in operation (for example, if it should be wrecked by a shell), two electric searchlights of 60,000 candle-power beam and wires connecting the electric plant with all parts of the fortification and connecting the stations by telephone.

The War Department has prepared the accompanying diagram to illustrate the system of control in the typical artillery station. The diagram is not arranged particularly for the works at Fort Wadsworth. In command of this fortification is a fort commander. Under the fort commander are two fire commanders, each being in control of three groups of guns. Each group in the diagram is composed of three guns, but the number may be more or less. Generally it is the number which one officer can supervise efficiently in action. Each of these officers is called a group commander. Between the fire commanders and the groups of guns is a line of range finders and position finders under a range finder commander and position finding officer. Finally each gun has its firing crew of three, under command of a gun director, who may be an officer or a non-commissioned officer. The guns are of course behind emplacements. At Fort Wadsworth nature has provided a natural defense in a high hill with a slope terraced to the edge of the water. Behind the hill the fortifications are constructed. On the hill above is the fort commander's station, which controls the approaches to the harbor. The telephone places the fort commander in direct communication with those under his command. The printing telegraph, unknown in the days of the Civil War, is also used in the scheme of communication. The fort commander sitting in his station, communicates his orders to the fire commander by telephone, giving information as to the general scheme of defense. The fire commander communicates with the range finder commander, and then on down the line to the group commander and thence to the three gun directors under him. Under this system the fort commander has perfect control over the guns. If a hostile fleet approaches, he can detect it from his elevated station long before the ships' guns have the fort in range. He can direct the attention of the fire commanders to it, if they have not seen it, and inform them with what guns he wants the firing on it opened. In accordance with a map of the harbor which lies before him he can direct that these guns be turned against a certain target or ship. The fire commanders will transmit his order to the position finding officers, who will indicate the position and range to the group commanders. Then the guns will be aimed and fired. The position finder occupies the most important station, because upon the accuracy of his work depends the effectiveness of a shot which will cost the government $1,000 and possibly cost the enemy $2,000,000 or the value of a modern warship. In aiming the guns allowance is made for the moving enemy and for the force of the wind. The firing is done by stop-watch and every second of time is important.



ARRANGEMENT OF FORT BATTERY.

Diagram designed by the War Department.

At the outbreak of the Spanish-American war, the government, owing to the parsimony of Congress, possessed no smokeless powder. In July 1903, millions of pounds of this explosive were safely stored at the various seacoast fortresses. When the American forces took possession of the fortifications at Havana, many of the front sights of the Spanish guns were missing. These cannon were made at Spanish arsenals, and it is supposed that the same defect existed in the guns on the Spanish warships, which may account for the slight damage inflicted upon American ships by the guns of Spain.

The modern system of seacoast defenses of the United States, comprises the following fortifications:

Fort Foster, Maine, on Gerrish's Island, in Portsmouth Harbor.
Fort Gorges, Maine, on Hog Island Ledge, in Portland Harbor.
Fort Preble, Maine, at Spring Point, in Portland Harbor.
Fort Scammel, Maine, on House Island, in Portland Harbor.
Fort Stark, N. H., at Jerry's Point, in Portsmouth Harbor.
Fort Warren, Mass., on Georgies Island, in Boston Harbor.
Fort Strong, Mass., at Long Island Head, six miles from Boston.
Fort Banks, Mass., at Grover's Cliff, near Boston.
Fort Adams, R. I., on Brenton's Point, near Newport.
Fort Greble, R. I., on Dutch Island, Narragansett Bay.
Fort Wetherill, R. I., on Conanicut Island, Narragansett Bay.
Fort Hamilton, N. Y., at The Narrows, New York Harbor.
Fort Lafayette, N. Y., at The Narrows, New York Harbor.
Fort Michie, N. Y., on Great Gull Island, 12 miles from New London, Conn.
Fort Tompkins, N. Y., on Staten Island, at The Narrows.
Fort Wadsworth, N. Y., on Staten Island, at The Narrows.
Fort H. G. Wright, N. Y., on Fisher's Island, entrance to Long Island Sound.
Fort Carroll, Md., at Seller's Point Flats, Patapsco River.
Fort Howard, Md., at North Point, Patapsco River.
Fort Smallwood, Md., at Rockpoint, 10 miles from Baltimore.
Fort Hunt, Va., Potomac River.
Fort Washington, Md., Potomac River.
Fort Moultrie, S. C., on Sullivan's Island in Charleston Harbor.
Fort Sumter, S. C., in Charleston Harbor.
Fort Oglethorpe, Ga., at Savannah.
Fort Pulaski, Ga., on Cockspur Island, Savannah Harbor.
Fort Taylor, Fla., at Key West.
Fort Barrancas, Fla., near Pensacola.
Fort Pickens, Fla., on Santa Rosa Island, near Pensacola.
Fort Gaines, Ala., on Dauphin Island, in Mobile Bay.

Fort Morgan, Ala., at Mobile Point.
Fort St. Philip, La., 65 miles below New Orleans.
Fort San Jacinto, Texas, near Galveston.
Fort Rosecrans, Cal., at San Diego.
Forts Miley, Baker, and Winfield Scott, Cal., in San Francisco Harbor.
Forts Casey, Columbia, Lawton, Walla Walla and Wright, Wash., in Puget Sound.

The foregoing are the new-type fortifications and in addition to these there are nearly 100 other forts along the Atlantic and Pacific seacoasts, not yet remodeled or equipped with the modern appliances of warfare. See ARMY OF THE UNITED STATES; ARTILLERY; MILITARY POSTS, U. S.

Fortiguerra, Niccolo, nē-kō-lō' fôr-tē-gwä'rä, Italian poet and prelate: b. Pistoia 7 Nov. 1674; d. Rome 17 Feb. 1735. A prelate at the court of Pope Clement XI. In his epic poem 'Ricciardetto,' so-called from one of the Paladins of Charlemagne, he wished to show that it was easy to imitate Ariosto. He wrote the first canto of this poem in one night, and continued it to 30 cantos. It appeared (1738) under the name of Carteromaco, which had been assumed by the author during his life. Its principal excellence consists in the description of situations. His short poems and sonnets are to be found in different collections of Italian poets.

Fortu'itism (Lat. *fors,* chance), a doctrine or theory of causation which denies the existence of a final end or object in the course of things. Such a doctrine in the domains of nature results in theories such as that of Darwin, who has been charged with denying design in the changes and developments of organized creatures, that is, the design of a single controlling mind, namely, of a supernatural creator. The opposite to fortuitism is teleology (q.v.), which is the theory of a final end or object in the processes of nature and history, as resulting from the plan or scheme originating in the mind of the Supreme Being.

Fortu'na (Gr. Τυχή), the goddess of success. According to Hesiod she was a daughter of Oceanus; according to Pindar, a sister of the Fates. She had temples at Corinth, Elis, and Smyrna, and worshipped in Italy before the building of Rome, and had a celebrated temple at Antium, in which were two statues, which were consulted as oracles, and gave responses either by signs or by lot. She had also a temple at Præneste, whence she was called *Dea Prænestina.* No less than 26 temples were erected to her in Rome, the first of which was built by Servius Tullius. She is generally delineated with two rudders, with one of which she guides the ship of prosperity, with the other that of misfortune. At a later period she was represented with a bandage over her eyes and a sceptre in her hand, and sitting or standing on a wheel or globe. She is usually dressed as a matron. On a coin of the Emperor Geta she is represented sitting on the earth with her bosom bare, her right hand resting on a wheel, and holding in her left hand, resting on her lap, a horn of plenty.

Fortunate Islands. See CANARY ISLANDS.

Fortuna'tus, a German collection of tales which originated about the end of the 15th century, though many of the tales and legends included in it are of much older date. The substance of the book is that Fortunatus and his sons after him are the possessors of an inexhaustible purse of gold and a wishing-cap, which however, in the end, prove the cause of their ruin. The moral is that worldly prosperity alone is insufficient to produce lasting happiness. The oldest printed edition of the book now extant bears the date 1509. Later German editions mostly bear the title, 'Fortunatus, von seinem Seckel und Wunsch-hütlein.' It has been reprinted in the third volume (1846) of Simrock's 'Deutsche Volksbücher.' Versions of the story have appeared in French, Italian, Dutch, Danish, Swedish, and even Icelandic. The first to dramatize the subject was Hans Sachs, in 'Der Fortunatus mit dem Wunschseckel' (1553), after whom comes the English Thomas Dekker, with his 'Pleasant Comedie of Old Fortunatus' (1600), a work which made its reappearance in German about 1620. The most poetical edition of the story is that given by Tieck in his 'Phantasus.' Consult Schmidt, in Ersch and Gruber's 'Encyklopädie' (Sec. 1, Vol. XLVI.).

Fortune, Robert, English author and botanist: b. near Berwick-on-Tweed, England, 1813; d. Scotland 16 April 1880. He learned gardening in early life, and gained a position in the botanical garden at Edinburgh. In 1842 he was appointed collector of plants for the Botanical Society of London in northern China. He published the results of his inquiries in his 'Three Years' Wanderings in the Northern Provinces of China' (1853). In 1848 the East India Company engaged him to visit China to compare the qualities and commercial value of different kinds of tea. He visited the East several times afterward and published an account of his numerous botanical discoveries in 'Two Visits to the Tea-countries of China' (1852); 'Residence Among the Chinese, Inland, on the Coast, and at Sea' (1857); 'Yedo and Peking' (1863).

Fortune Bay. By the fisheries treaty of 1871 with Great Britain (see FISHERIES QUESTION), the American fishermen were granted equal rights on all British coasts. The Newfoundlanders were very jealous of this intrusion on their fishing grounds, and in 1878 the Fortune Bay fishers attacked and drove away some Gloucester vessels. Demand was made on Great Britain for damages, and £15,000 was ultimately paid.

Fortune-telling, predicting the future of an individual, by means of signs or indications noticed by the fortune-teller. Chiromancy is the art of reading the lines or wrinkles on the palm of the hand, as indicative of the future for the person so marked. Necromancy is the art of consulting the dead about the future. In chartomancy playing cards are supposed by their suit or denomination when turned up after being dealt out, to reveal coming events. The ancient astrologer used to decide from the stars the good or bad fortune of an individual, the hour and day of whose birth was taken as data in calculating the planetary conjunctions on which the horoscope was based. In every great city, even of the modern world, there are hosts of people who make a profession of fortune-telling, and there are many more who are credulous enough to believe in their pretensions. The law does not recognize the power of anyone to foretell the future, and the deluded victim of such charlatans, who has paid the wizard for a supposed revelation of the future, can bring the latter to justice for obtaining money on false pretences. In the ancient world there was a strong belief in fortune-telling, or the power to predict the future. At Rome the government appointed official fortune-tellers of the state, who from the flight of birds or the appearance presented by the entrails of sacrificial victims made calculations as to coming events. The oracles of Delphi and Dodona were consulted by the wisest and best pagan Greeks. At Rome fortunes were told, or believed to be told, by Fortune herself in her temple at Antium. The literature of the Middle Ages is full of allusions to fortune-telling, which also played a part in the fiction and drama of all countries up to the middle of the 19th century. The belief in witches, wizards, and fortune-tellers has utterly disappeared among educated people, as fortune-telling has disappeared from literature. This results, to a large extent, from the advances made in physical science, the clearer views which prevail concerning causation, and the limits of human experience. Rationalism, in its newest form of agnosticism, has likewise cleared the intellectual atmosphere, and made delusion and imposture less and less able to obtain a footing or exercise an influence over sane minds.

Fortunes of Nig'el, The, an historical novel, with scene laid in the London of James I., published by Sir Walter Scott in 1822. The introduction to this work contains interesting self-criticism by the author.

Fortuny y Carbo, Mariano, mä-rē-ä'nō fŏr-too'nē ē kär'bō, Spanish painter: b. Reus near Barcelona 11 June 1839; d. Rome 21 Nov. 1874. He studied at Madrid, traveled in Morocco, and settled at Rome, where he became the centre of a school of artists in revolt against over-study of the «masters.» In 1866 he went to Paris, where his pictures, mostly genre subjects from Southern and Oriental life, had a great success. Among the best known are: ‹A Spanish Marriage›; ‹A Fantasia at Morocco›; ‹The Academicians at Arcadia›; ‹The Seashore at Portici.› The Metropolitan Museum of New York contains his ‹Lady in Black,› and ‹Camels at Rest,› and many other pictures of his are contained in public and private American art collections. He was also known as an able etcher. See Lives by Davillier (1875), and Yriarte (1886); Muther, ‹History of Modern Painting› (1890).

Forty, a number that has sometimes been regarded as peculiarly significant. The idea may have originated with readers of the Bible, who notice that Moses was 40 days on the mount; Elijah was 40 days fed by ravens; the rain of the flood fell 40 days, and another 40 days expired before Noah opened the window of the ark; 40 days was the period of embalming; Jonah gave Nineveh 40 days to repent; our Lord fasted 40 days. He was seen 40 days after his resurrection, etc.

The weather on St. Swithin's Day portends, as it is foul or fair, 40 days' rain or dry weather; a quarantine extends to 40 days; 40 days, in the old English law, was the limit for the payment of the fine for manslaughter; the privilege of sanctuary was for 40 days; the widow was allowed to remain in her husband's house for 40 days after his decease; a knight enjoyed 40 days' service of his tenant; a stranger at the expiration of 40 days was compelled to be enrolled in some tithing; members of Parliament were protected from arrest 40 days after the prorogation of the house, and 40 days before the house was convened.

Forty Immortals, The, the members of the French Academy. See Academy, French.

Forty Thieves, a band of robbers in the tale ‹Ali Baba› in the ‹Thousand and One Nights.› They dwell in a cave, the door of which opens at the words «Open, Sesame.»

Forum (Lat. for a market-place; connected with *foris*, out of doors), the open space in the centre of a city, in Roman times, where the people assembled, as on common ground, for amusement or the transaction of business. Here elections were held; here were the public buildings, civic and administrative. Included in the forum was the comitium, with its tribunals for the orators who addressed the people. The *curia* or senate house stood, with other buildings, on the forum; and between the public edifices stretched lines of shops or *tabernæ*.

In the days of the kings and under the early republic there was but one forum in each city, small or great. In this open space all public business, political and legal, and all mercantile transactions were carried on. Dramatic representations, exhibitions of gladiators, combats of wild beasts and horse races also took place in the forum. The single forum eventually gave place to two forums, one of which was given up to law administration and politics, and the other to mercantile traffic. Eventually, each important commodity had its own forum. There was the *forum boarium*, cattle market; *forum suarium*, hog market; *forum olitorium*, vegetable market; and *forum piscarium*, fish market. The trade shops, as of gold- and silver-smiths, saddlers, blacksmiths, tinsmiths, money-lenders, booksellers, etc., were ranged round these fora, or occupied streets adjacent to them. The temples that edged the forum at Rome, like the mediæval cathedrals, were sometimes used for secular purposes. Thus, the senate often held meetings in the Temple of Concord, while the Temple of Saturn was used as state treasury, and was also the depositary of public archives, before the erection of the Tabularium. There are a great many ruins which enable us to gain a fair idea of the fora of other cities beside Rome. The fora at Pompeii are as follows. The principal forum; 450 feet from north to south: in its north side was the Temple of Jupiter, the Basilica, or law court, and the temple of Apollo; on the west and on the east side the *macellum* (meat market), the *senaculum* or curia, the Temple of the Genius of Augustus, and the *Scholæ* or corporation building. The triangular forum, *forum triangulare*, contained a Doric temple to the south, and an Ionic portico at the entrance.

In the open spaces of the forum were set up many statues of distinguished men. Even in the days of the republic it was necessary to order the clearing out of such statues, together with crowds of altars, arches, and memorial columns which blocked up the place.

The forum par excellence was of course the original Forum Romanum. It was situated in the hollow between the Palatine, Capitoline and Quirinal hills. The early tribes met on this common and neutral ground. Under the Tarquins the consolidation of the tribes is suggested by the completely adorned and enclosed appearance of the Forum. The Temple of Saturn appeared in 497 B.C., that of the Dioscuri in 484 B.C., that of Concord in 367 B.C. The first court-house, Basilica Porcia, was not built before 184 B.C.; three more were built later, and it was this increase of buildings that occupied so much of the vacant space that the fish, meat, hog, vegetable and other markets were obliged to retire to other quarters of the city.

Julius Cæsar was the first to add special forums to those already in existence, and his Forum Julium was followed by the Forum Martis of Augustus, sometimes called Forum Augustus. Then came the Forum Pacis of Vespasian, the Forum Transitorium of Domitian and Nerva, the Forum Trajani of Trajan. These all lay side by side, north and east, with the Forum Romanum. The Forum Julium had in its centre a temple of Venus Genetrix, the patron goddess of the Julian gens round which it formed a sort of sacred precinct. The Forum Augustum was dedicated to Mars and in it was situated the Temple of Mars Ultor. This building was flanked by two triumphal arches, and Cæsar had intended that it should commemorate, with appropriate statues, the extension of Roman dominion. The Forum Nervæ was dedicated to Minerva and contained her temple. As the main thoroughfare through this district of the city crossed this forum it was commonly known as Forum Transitorium. The most gorgeous architectural group in the imperial city was exhibited in the Forum Trajani, which had its own special Basilica, like the great forum. It was entered by a triumphal arch, surrounded by a double colonnade; an equestrian statue of the emperor stood in the centre, flanked on each side by a half circle. The Library, Column and Temple of Trajan completed the cluster of marble structures.

The appearance of the Forum Romanum during the last days of the empire may be described as follows: Looking toward the Capitol the spectator would see the Temples of Concord, of Vespasian, and the Dii Consentes. The Temple of Saturn stood between the slope of the Capitol and the Vicus Jugarius. Beside it was the Arch of Tiberius, near that of Septimius Severus. Between these two arches were the rostra. The political buildings stood on the farther side of the arch of Severus. Here was the Senate house or the Curia, while the Temple of Janus rose side by side with the Basilica Æmilia. On the south and opposite side was the vast Basilica Julia, and the beautiful Temple of the Dioscuri. East from this group of buildings was an open space occupied by the Temple of Julius, side by side with which was the triumphal arch of Augustus, and beyond these is the most interesting tract of the old forum, the centre of antique and primitive Roman religion. The Shrine of Vesta, the Temple of Antoninus and Faustina, the Templum Urbis made up a magnificent range of noble and solemn structures, and we are reminded also that at this point once stood the arch of the Fabii at the opening of the ancient Via Sacra.

The invasions of the Goths did not bring much destruction upon the forum. It was in the 11th century that the buildings were devastated at the sacking of Rome (1084), when Gregory VII. was delivered from the Castle of San Angelo by Duke Guiscard. The rarest monuments of the antique world were employed as fortresses. The 16th century witnessed the antiquarian curiosity and reckless vandalism of the Renaissance. The Forum of Cicero and Augustus became a wilderness with only a few isolated columns to mark the site of temples or palaces. Under the learned and liberal Pius VII. the relics were preserved from further destruction and the archæologist Carlo Fea then began those excavations which have been continued by Lanciani.

Bibliography.—Jordan, 'Topographie der Stadt Rom im Alterthum' (1871); Middleton, 'The Remains of Ancient Rome' (1892); Nicholas, 'The Roman Forum' (1877); Lanciani, 'Ruins and Excavations of Ancient Rome' (1897); Boni, official report of excavations, 'Notizie degli scavi' (1899 et seq.); Platner, 'Topography and Monuments of Ancient Rome' (1904).

Forum Ecclesiasticum, a church tribunal or court. It is either internal or external—*Forum Internum, Forum Externum.* The *Forum Internum* is what is known as the tribunal of penance, the confessional, where the penitent is both accuser and accused; and the confessor is the judge who condemns or acquits or pardons, and exacts satisfaction for wrongs and reparation of injury done to others whether in reputation or property. The *Forum Externum* is any ecclesiastical tribunal outside of the sacrament of penance that is concerned with church government. What are the sanctions by which the judgments of the Church's tribunals are enforced? Has the Church the right to inflict temporal pains and penalties on offenders against her laws? That the Church does possess such power is the teaching of the Church herself: the doctrine which declares she does not possess it has been explicitly condemned. The proposition that "the Pope or the whole Church collectively cannot punish any man, however wicked he may be, with a coercive penalty" unless the civil power gives them authority to do so, is condemned by Pope John XXII., and a similar proposition was condemned by Pope Pius VII. in the bull *Auctorem Fidei:* one of the propositions condemned by Pope Pius IX. in the *Syllabus* (1864) declared that "the Church has no power to employ force." In proof of the necessity of such power in the Church, the case of a bishop is cited who teaches heretical doctrine: has not the Church, it is asked, power to depose him; or must the matter go before a tribunal of the civil power? It is held that to make such resort to the secular courts necessary is to render the Church powerless to execute her divine commission, and to make a civil judge the judge of a purely ecclesiastical cause. On the ground of the canon law the Church has the right in herself "to inflict stripes, to impose fines, to imprison in a monastery" offenders against her laws; in short, to impose all penalties short of the effusion of blood, *citra sanguinis effusionem,* or its equivalent. Practically, the power of the Church at present is confined to the infliction only of her spiritual penalties, and these only when they do not in any degree directly or indirectly impair the civil rights of the person who incurs the spiritual censures; when they do so trench on his civil rights, the person has recourse to the secular courts. Thus in this country cases are often brought into the civil tribunals of rectors of parishes or pastors of churches who have been deposed by bishops or other ecclesiastical superiors; and courts find it within their competence to decide whether the act of the superiors has been done in entire conformity with the constitution and laws of the religious body concerned, and the civil and contractual rights of the complainant.

Forward, Walter, American statesman: b. Connecticut 1786; d. Pittsburg 24 Nov. 1852. He studied law and was admitted to the bar in 1806. In 1822 he was elected to Congress; and in 1841 was appointed by President Harrison first comptroller of the treasury, and was reappointed by President Tyler in September of the same year. On retiring from the cabinet in 1843 he resumed law practice. In 1849 he was appointed *charge d'affaires* to Denmark, but resigned in 1851.

Forwood, William H., American military surgeon: b. Delaware 7 Sept. 1838. He was graduated at the medical department of the University of Pennsylvania and at Georgetown University, Washington, D. C.; entered the regular army as an assistant surgeon in 1861, and served throughout the Civil War. He also served in many Indian campaigns; was surgeon and naturalist with the exploring expedition through Wyoming, Montana, and Idaho, in 1883; located military hospitals in Savannah, Ga., and the camp hospitals in Montauk Point, during the Spanish war; and was appointed surgeon-general of the army with the rank of brigadier-general in 1902.

Foscari, Francesco, frän chĕs'kō fŏs kä'rē, doge of Venice: b. 1372; d. Venice 1 Nov. 1457. In 1416 he was named procurator of St. Mark's, and in 1423 was elected doge. His son Giacopo, being accused of ordering the assassination of a senator Donati, the enemies of the family created such commotion in the state that, unable to clear himself to their satisfaction of the charge, he was banished from the city, the father having to ratify the sentence. Love of his country, and devotion to his wife, compelled the banished Foscari at all hazards to revisit his beloved Venice, where, being discovered by his enemies, he was denounced, again made prisoner, put to the question of the rack, and a second time banished, dying soon after of his wounds, or the torments of his secret punishment, and of grief at separation from his idolized family. The fate of the son had such an effect on the doge that the bereaved father went mad, in which state the enemies of his family compelled him to abdicate. He died three days after in a spasm, upon hearing the bells of St. Mark's announce to Venice the election of a new ruler. Byron has written on the subject a tragedy entitled 'The Two Foscari.'

Foscolo, Ugo, oo'gō fŏs'kō-lō, originally **Niccolo,** Italian author: b. Zante, one of the Ionian isles, 26 Jan. 1778; d. Turnham Green, near London, 10 Oct. 1827. A man of passionate temperament, and withal an ardent patriot, Foscolo was bitterly disappointed when by the Treaty of Campo Formio Venice was given to Austria, and his disappointment found vent in the 'Lettere di Jacopo Ortis' (1802), a sort of political Werther. Becoming finally undeceived as to Napoleon's intentions with regard to his native land, he returned to Milan, where he published in 1807 his best poem, 'I Sepolcri,' a work composed in the spirit of the ancient classic writers, and remarkable for its smooth and polished versification. About this time he wrote a translation of Sterne's 'Sentimental Journey,' and two tragedies, 'Ajace' and 'Ricciarda,' both showing political tendencies. In 1899 he was appointed to the chair of eloquence in Pavia. His inaugural address, 'Dell' Origine e dell' Ufficio della Letteratura,' although full of the same love of classic beauty which marks the 'Sepolcri,' is turgid and affected in style. When in 1814 the Austrians entered Milan, Foscolo withdrew to Switzerland, and in 1816 he went to London. There some of his best writings were published, namely: 'Essays on Petrarca'; 'Discorso sul testo del Decamerone'; 'Discorso sul testo di Dante.' His remains were finally deposited in the Church of Santa Croce, Florence, in 1871.. His works and letters were published at Florence in 12 volumes by Le Monnier (1850–62). Consult Lives by Pecchio (1836); Carrer (1842); Artusi (1878); Antona Traversi (1884); and De Winckels (1885–6).

Fos'dick, Charles Austin («HARRY CASTLEMON»), American writer of juvenile books: b. Randolph, N. Y., 6 Sept. 1842. He served in the Union navy in the Civil War from 1862 to 1865. Besides contributions to periodicals, he has published under the pseudonym «HARRY CASTLEMON» over 30 books for boys, among which are: 'The Gunboat Series' (1864–8); 'Rocky Mountain Series' (1868–71); 'Rod and Gun Series' (1883–4); 'The Buried Treasure'; 'The Steel Horse'; 'Jack the Trader'; 'The Houseboat Boys'; etc.

Fosdick, William Whiteman, American poet: b. Cincinnati, Ohio, 28 Jan. 1825; d. there 8 March 1862. He gained some distinction as a poet by a drama entitled, 'Tecumseh.' He also published: 'Malmiztic the Toltec' (1851), and 'Ariel and Other Poems' (1855).

Foss, Cyrus David, American Methodist bishop: b. Kingston, N. Y., 17 Jan. 1834; d. Philadelphia, Pa., 29 Jan. 1910. Having been graduated at Wesleyan University in 1854, he became an itinerant in the New York Conference of the Methodist Episcopal Church in 1857, was pastor at Chester, N. Y. (1857–9), Brooklyn (1859–65), and New York (1865–75). In 1875–80 he was president of Wesleyan University, and in the latter year was elected bishop. He made official missionary tours of the stations of the Methodist Episcopal Church in Europe (1886), Mexico (1893), and India and Malaysia (1897–8).

Foss, Sam Walter, American poet: b. Candia, N. H., 19 June 1858. He has been librarian of the Somerville, Mass., public library from 1898. His published works include: 'Back Country Poems' (1894); 'Whiffs from Wild Meadows' (1895); 'Dreams in Homespun' (1897); 'Songs of War and Peace' (1898).

Fos'sa, or **Foussa,** a large, brown, unstriped carnivorous mammal of Madagascar (*Cryptoprocta ferox*), which has the form of a huge weasel (twice the size of a house-cat), and like a weasel is lithe, active and bloodthirsty. Its systematic place is by no means decided. It is placed by Beddard as representing a distinct sub-family of the civets; while Mivart and Lydekker regard it merely as a genus of civets. Zittel, in view of its dentition and the retractibility of the claws, among other features, regards it as occupying an intermediate place between the civets and the cats, and associated with such composite extinct forms as *Dinictis, Proælurus* and *Pseudælurus,* but classifies it in the *Felidæ*. It is the largest carnivore in Madagascar, and preys chiefly on birds and lemurs.

Fossil Footprints. See ICHNOLOGY.

Fossil Plants. See PALÆOBOTANY.

Fossil Vertebrates. See FOSSILS; PALÆONTOLOGY.

Fossilif'erous Rocks, rocks in which are found embedded the petrified remains, or molds of plants and animals. See FOSSILS; PALÆONTOLOGY; etc.

Fossils, the impressions or remains of plant or animal forms preserved in rocks by natural causes. Fossils supply data, from which the geologist can determine the relative ages of sedimentary rocks. The first man to realize their chronological importance was the English surveyor, William Smith, known as the father of historical geology, although acute observers like Leonardo da Vinci had pointed out long before that fossil shells were not freaks of nature, but had been laid down where found in the sediments of some body of water.

Most fossil remains are of marine types; many are of fresh-water and land-and-water types; comparatively few are of land types. The reason is plain. Animal remains lying on the ground are eaten by animals, or if not eaten, soon decay, and the bony skeleton, if buried by sand or loam, is slowly dissolved by percolating water. Plant remains decay even more rapidly. In water, decay is retarded. Thus mastodon remains have been found in swamps where the animals were occasionally mired, but of the infinitely greater number of mastodons that died on drier ground no trace is left. Old lake beds are frequently rich in plant and animal remains. Fishes, insects, birds, and land animals, and the leaves, flowers, and fruits of trees are preserved in the fine-grained shales or the sands and clays of the lake deposits in several western States. In old swamps, plants formed thick masses of vegetable matter, now turned to coal, imprints of leaves and stems being common in the shale overlying a coal-seam. In the sea, conditions are most favorable for the preservation of organic remains, and marine deposits have formed thick and extensive beds. Hence, of all the fossils found, marine types are most numerous. Fossils are preserved in several ways, which may be classified under three heads. (1) Some of the original substance may be preserved, as the carbon in a leaf, or the bone or shell of some animal. (2) All the original substance may dissolve away, but its shape may be preserved. This may happen in two ways: (*a*) the external form may be preserved in the sediments, forming a mold, or (*b*) the internal form may be preserved, forming a cast. A mollusk dies; its soft parts decay; the interior of the shell fills with sand or ooze; the shell is deeply buried. The sediments consolidate; the calcareous material of the shell may dissolve; but both its external and internal form are preserved. (3) In rare cases the structure of organic remains is preserved by a true petrifaction, the organic substance being replaced, atom by atom, by some mineral compound, like silica or calcium carbonate. A striking illustration of this method of preservation is fossil wood, in which the replacing silica preserves minute details of structure. See COAL; CORAL ISLANDS; GEOLOGY; PALÆONTOLOGY; PALÆOBOTANY.

Foster, Abby (KELLEY), American reformer: b. Pelham, Mass., 1811; d. 1887. She was married to S. S. Foster (q.v.) in 1845. At first a teacher, from 1837 she appeared as a platform lecturer in support of the abolition of slavery, being the first woman to assume this role, and she suffered much harsh treatment from the opposition. After her marriage she traveled and lectured with her husband, and later spoke also in behalf of woman's suffrage and prohibition.

Foster, Benjamin, American artist: b. North Anson, Maine. A pupil in New York of Abbott Thayer, and in Paris of Luc Oliver Merson, and Aimé Morot, he obtained various recognition of his excellence in landscape, including a bronze medal at the Paris Exposition of 1900, and the Webb prize of the Society of American Artists in 1901. Among his works are: 'Mists of the Morning,' for which he received the Webb prize, and 'Night Scene at the Paris Exposition,' purchased by the French government for the Luxembourg Gallery.

Foster, Birket. See FOSTER, MYLES BIRKET.

Foster, Charles, American legislator and cabinet officer: b. near Tiffin, Ohio, 12 April 1828; d. Springfield, Ohio, 9 Jan. 1904. He entered a mercantile career at Rome, now Fostoria, Ohio, and became the proprietor of the largest country business in the State. At the time of the Civil War he was active in the recruiting of troops. In 1870 he was elected to Congress in a district previously strongly Democratic, and in 1872, 1874, and 1876 was rechosen. While in Congress he was for some time a member of the ways and means committee. He was elected governor of Ohio in 1879, and again in 1881, his administration being marked by special attention to the non-partisan management of public institutions. In 1891 he was appointed secretary of the treasury by President Harrison, and in that post he negotiated a loan of $25,364,520 at the unprecedentedly low rate of 2 per cent. Subsequently he was a commissioner on several diplomatic missions of importance and performed his duties with great skill and satisfaction to his government.

Foster, David Skaats, American author: b. Utica, N. Y., 1852. After a common-school education at Utica, he there entered the coal and iron business. His publications include: 'Rebecca the Witch and Other Poems'; 'Elinor Fenton,' a novel; 'Spanish Castles by the Rhine,' and 'Prince Timoteo.'

Foster, George Eulas, Canadian statesman: b. Carleton County, New Brunswick, 3 Sept. 1847. He was graduated at the University of New Brunswick in 1868, studied also at Edinburgh and Heidelberg, was professor of classics and history in the University of New Brunswick in 1872–9, and in 1882 was elected to the Canadian Parliament. In 1885–8 he was minister of marine and fisheries; in 1888–96 minister of finances. Upon his visit to England in 1894 in connection with Dominion finances, he negotiated a loan of $11,250,000. He was government leader in the Commons in 1895.

Foster, Gilbert, English artist: b. Manchester, England, 9 May 1855. He studied art with his father, a portrait painter, and exhibited his first picture at the Academy in 1876, since which date he has been a yearly exhibitor. Among his paintings are: ‘Lingering Light’ (1890); ‘Birds of a Feather’ (1891); ‘The Last Faint Pulse of Quivering Light’ (1892); ‘The Azure Mead’ (1895); ‘Hush of Night’ (1898); ‘A Garden of Lyonnesse’ (1900); ‘A Garden of Memories’ (1901).

Foster, Hannah (WEBSTER), American novelist: b. 1759; d. Montreal, P. Q., 17 April 1840. Her published works are: ‘The Coquette, or the History of Eliza Wharton,’ one of the earliest of American novels; ‘The Boarding School’ (1796); and ‘Lessons of a Preceptress’ (1798).

Foster, Henry, English scientist: b. Woodplumpton, Lancashire, 1797; d. Isthmus of Panama 5 Feb. 1831. He entered the royal marines, but after the peace of 1815 devoted himself chiefly to astronomical studies. The gold medal of the Royal Society of Great Britain was awarded him for his services on the Arctic Expedition of Capt. Ross in 1818–19. On 27 April 1828, he sailed on the Chanticleer, as commander of an expedition to determine the direction of the principal ocean currents in both hemispheres. He was drowned while exploring the Chagres River in Panama.

Foster, John, English essayist: b. Halifax, Yorkshire, 17 Sept. 1770; d. Stapleton, near Bristol, 15 Oct. 1843. A Baptist clergyman, self-educated and with an advanced point of view, he contributed to the ‘Eclectic Review’ regularly as well as delightfully; but his volume of ‘Essays’ (1805) constitutes his chief title to recognition. Four in number, these compositions are respectively: ‘On a Man's Writing Memoirs of Himself’; ‘On Decision of Character’; ‘On the Application of the Epithet Romantic’; and ‘On Some of the Causes by which Evangelical Religion has been Rendered Less Acceptable to Persons of Cultivated Taste.’ All are marked by great solidity and depth of thought, combined with a lucidity and nervousness of style which no English author has surpassed. Of the four essays the palm is generally given to that ‘On Decision of Character,’ though in the opinion of Robert Hall the fourth of the series was the work on which Foster's fame with posterity would rest. As a preacher Foster never succeeded in attracting much attention. His discourses, though solid and philosophical, were of too abstract and unadorned a nature to be readily appreciated by a popular audience. In 1817 he wrote his ‘Essay on the Evils of Popular Ignorance, in which he exposed the fearful condition of the masses in the large towns of England, and strenuously urged the establishment of a national system of education.

Foster, John Gray, American military officer: b. Whitefield, N. H., 27 May 1823; d. Nashua, N. H., 2 Sept. 1874. He was graduated at the United States Military Academy in 1846, entering the engineer corps. At the outbreak of the Civil War he was assigned to duty at Fort Sumter and was one of its garrison during the siege. In 1861 he was commissioned a brigadier-general of volunteers; took a leading part in the capture of Roanoke Island in 1862; was promoted major-general of volunteers; and became commander of the Department of North Carolina, defending that region with skill. Subsequently he commanded the Departments of Ohio and Florida, and in 1865 was brevetted major-general, United States army.

Foster, John Watson, American diplomatist: b. Pike County, Ind., 2 March 1836. He was graduated at the Indiana State University in 1855; studied law, and was admitted to the bar in Evansville, Ind. After the Civil War, during which he served in the Federal army with distinction, he was editor of the Evansville *Daily Journal* and postmaster of that city; minister to Mexico in 1873–80, to Russia 1880–1, and Spain 1883–5. He was special commissioner to negotiate reciprocity treaties with Spain, Germany, Brazil, and the West Indies in 1891; and United States secretary of state 1892–3. Subsequently he was the agent for the United States before the Bering Sea Arbitration Tribunal at Paris; participated in the peace negotiations with Japan; and in 1898–9 served as a member of the Anglo-American Joint High Commission. He has published a pamphlet, ‘The Alaskan Boundary’ (1899), and ‘A Century of American Diplomacy 1776–1876’ (1900).

Foster, John Wells, American geologist: b. Brimfield, Mass., 1815; d. 1873. He was graduated at Wesleyan University in 1834, and having removed to Ohio, studied law and was admitted to the bar there; in 1837 became an assistant in the geological survey of Ohio; and in 1847 was appointed an assistant to Prof. Jackson in a survey of the region about Lake Superior. The results of this survey, executed in connection with J. D. Dana, appeared in several volumes published by authority of Congress. Foster aided in the organization of the Republican party in Massachusetts, and from 1858 was resident in Chicago, where he made a notable study of the ethnology and palæontology of the Mississippi basin. Among his works are: ‘The Mississippi Valley’ (1869); ‘Prehistoric Races of the United States’ (1873).

Foster, Judith Ellen (HORTON), American temperance advocate and lecturer: b. Lowell, Mass., 3 Nov. 1840; d. 11 Aug. 1910. She studied law and in 1872 was admitted to the State bar of Idaho. In 1870–84 she was superintendent of the legislative department of the National W. C. T. U., and upon the affiliation of the society with the Prohibition party, joined the Non-Partisan W. C. T. U., of which she was president in 1889–93. Her publications include: ‘Constitutional Amendment Manual’ (1882); ‘The American Renaissance.’

Foster, Lafayette Sabine, American statesman: b. Franklin, Conn., 22 Nov. 1806; d. Norwich, Conn., 19 Sept. 1880. He was graduated at Brown University in 1828 and admitted to the bar in 1830; took an active part in Connecticut politics, and was elected to the legislature in 1839, serving several terms. He was elected to the United States Senate in 1854; was president pro tem. of the Senate in 1865; and, after Andrew Johnson became President, was acting Vice-President of the United States. His senatorial term expired in 1867, but on account of his moderate and conservative course in the Senate his re-election was strongly opposed, and he withdrew his name. In 1870 he was again elected to the State legislature, but resigned in June of that year to take his seat on the bench of the Connecticut supreme court. In 1878 he was appointed a member of the commission to devise simpler forms of legal procedure for State courts, and in 1878–9 was commissioner from Connecticut to settle the disputed boundary question with New York.

Foster, Sir Michael, English physiologist: b. Huntington 8 March 1836; d. London, 29 Jan. 1907. He was a surgeon 1860–6; became prælector of physiology at Trinity College, Cambridge, in 1870, and from 1883–1903 was professor of physiology at Cambridge. He was president of the British Association in 1899 and was knighted the same year, and was member of Parliament for London University from 1900. He published: ‘Text Book of Physiology’; ‘Lectures on History of Physiology,’ etc.

Foster, (Myles) Birket, English artist: b. North Shields 4 Feb. 1825; d. Weybridge, Surrey, 27 March 1899. He began his artistic career as a wood-engraver, executing illustrations for ‘Punch’ and the ‘Illustrated London News,’ and for several volumes of English classics. From 1859 he drew much in water-color, being particularly successful in his presentation of rural life and landscape. Among his subjects in this genre are: ‘Nutting’; ‘Feeding the Ducks’; and ‘Cows in the Pool.’ His works are widely popular in England, where they have been much engraved.

Foster, Randolph Sinks, American Methodist clergyman: b. Williamsburg, Ohio, 22 Feb. 1820; d. Newton, Mass., 1 May, 1903. He was educated at Augusta College (Millersburg, Ky.), entered the Methodist Episcopal ministry as an itinerant in 1837, was transferred from the Kentucky conference successively to Ohio and New York, and was president of the Northwestern University 1857–60. In 1868 he became a professor in Drew Theological Seminary (Madison, N. J.), and in 1872 president of the institution. In the latter year he was also elected bishop, and in 1896 retired from the ministry. Among his publications are: ‘Centenary Thoughts’; ‘Studies in Theology’; ‘Philosophy of Christian Experience.’

Foster, Robert Verrell, American theologian: b. Wilson County, Tenn., 12 Aug. 1845. He was educated at Cumberland University (Lebanon, Tenn.), and the Union Theological Seminary, and from 1877 has been a professor in the former, originally of Hebrew and New Testament Greek, subsequently of systematic theology. Of his publications may be named: ‘Old Testament Theology’ (1890); ‘Systematic Theology’ (1898).

Foster, Roger, American lawyer: b. Worcester, Mass., 1857. He studied at the University of Marburg, Yale, and the Columbia Law School, in 1880 was admitted to the New York bar, and was special counsel to the board of health of New York in 1896–8. His writings include, besides many pamphlets and articles in periodicals: ‘A Treatise on Federal Practice’ (1890–2); ‘A Treatise on the Income Tax of 1894’ (1895).

Foster, Stephen Collins, American songwriter: b. Pittsburg, Pa., 4 July 1826; d. New York 13 Jan. 1864. He was educated at Athens Academy and Jefferson College, Pennsylvania. He composed the music and wrote the words of over 125 popular songs and melodies, among which are: ‘Old Folks at Home’; ‘Nelly Gray’; ‘Old Dog Tray’; ‘Come Where my Love Lies Dreaming’; ‘Suwanee River’; etc.

Foster, Stephen Symonds, American abolitionist: b. Canterbury, N. H., 1809; d. 1881. He was graduated at Dartmouth College in 1838; studied theology at the Union Seminary, became an anti-slavery orator, and was known for his radical methods. His attacks upon the Church for its position in regard to abolition aroused hostility against him, and his practice of interrupting church services was the cause of several mob disturbances. He published ‘The Brotherhood of Thieves: A True Picture of the American Church and Clergy’ (1843).

Foster, Theodosia Toll («Faye Huntington»), American author: b. Verona, N. Y., 1838. She was married to James H. Foster 1869. She was educated at the Oneida Seminary, and was for many years principal of a school at Verona. Her works include a long series of volumes of fiction, such as: ‘Ripley Parsonage’ (1877); ‘What Fide Remembers’ (1885); ‘The Boynton Neighborhood’ (1895); and ‘Lewis Elmore — Crusader’ (1898).

Fosto'ria, Ohio, a city in Seneca County, 35 miles from Toledo, on the Baltimore & O., and Lake Erie & W. R.R.'s. It was named in honor of Charles Foster, governor of Ohio (1891–3), who was influential in building many factories here. Pop. (1910) 9,597.

Fothergill, fŏth'ėr-gĭl, **Jessie**, English novelist: b. Manchester, England, 7 June 1856; d. London 30 July 1891. Her stories show a keen faculty of observation, and include: ‘Healey, a Romance’ (1875); ‘Aldyth’ (1876); ‘The First Violin’ (1878), in which German life is faithfully portrayed; ‘Probation’ (1879); ‘Kith and Kin’ (1881); ‘Made or Marred’; ‘Borderland’ (1886); ‘One of Three’; ‘The Lasses of Laverhouse’ (1888); ‘A March in the Ranks’ (1890); ‘Oriole's Daughter’ (1893).

Fotheringay (foth'ėr-ĭn-gā) **Castle, the site** of which was near Peterborough, England, 27 miles northeast of Northampton. The castle to which a melancholy interest attaches as the scene of the imprisonment, trial, and execution of Mary Queen of Scots, was demolished by her son James I. Several of the illustrious Plantagenets are buried in its church.

Foucault, Jean Bernard Léon, zhŏṅ bär-när lā-ôṅ foo-kō, French scientist: b. Paris 18 Sept. 1819; d. there 11 Feb. 1868. He was editor of the ‘Journal des Débats’ from 1845, in 1854 became physicist to the Imperial Observatory, and in 1855 received the Copley medal of the Royal Society of London for his measurement of the velocity of light. His inventions include a device much used in the employment of the electric light in microscopic and optical researches. He also demonstrated (1851) by means of the pendulum and the gyroscope, the rotation of the earth upon its axis.

Foucault Currents, or **Eddy Currents**, are electrical currents generated by induction within the substance of a massive conductor that is moving in a magnetic field, or which is exposed to the influence of a variable field. If the conductor is filiform, like a wire, no current can be produced in it save in the direction of its length. If a massive conductor be thought of, however, as composed of an infinite number of closed circuits, each composed of a single wire, and all tangled up and then melted into a solid mass, it is evident that (in general) currents will be induced in all of these imaginary circuits when the conductor moves, or when the field to which it is subjected varies. In the actual case the conductor is not composed of wires melted together, but currents are nevertheless generated within it just as though these wires had an actual objective existence. Mathematical equations can in fact be written down, from which it is possible to compute the direction and intensity of the current that is flowing, at any given instant, through any proposed point of a conductor in a known but varying field. Such calculations are seldom made outside of college class-rooms, however, because it is known from the general principle of the conservation of energy that the direction of the Foucault currents is everywhere such as to oppose the change (of whatever sort it may be) which produces them. Hence such currents tend to diminish the efficiency of all motors, dynamos and transformers in which they occur, and designers therefore strive to avoid them so far as possible. In armatures and in transformers, for example, it is customary to laminate the masses of iron that are exposed to changing fields, the individual parts being insulated from one another by air gaps or otherwise, and their surfaces of separation disposed (as nearly as practicable) so as to be perpendicular to the direction in which the Foucault currents tend to flow. In galvanometers, masses of copper are often purposely disposed near the sensitive needle with distinct advantage; for while they do not affect the total deflection of the needle, they cause it to come to rest very quickly after the circuit is broken, the motion of the needle inducing Foucault currents in the copper, which tend always to bring the needle to rest. The energy that is expended in the generation of Foucault currents is transformed into heat, and raises the temperature of the mass within which the currents are flowing. The name refers to the French physicist Foucault, who studied the subject with much care.

Foucault's Pendulum Experiment, a curious and remarkable method invented by Jean Bernard Léon Foucault (q.v.), of showing the rotation of the earth on its axis, by observing a vibrating pendulum, and his experiment goes under the above name. In this experiment a graduated disk is seen to turn, while a pendulum freely suspended maintained its plane of oscillation. If a heavy ball is suspended by a fine wire and set to vibrate like a pendulum, it may easily be shown, either mathematically or by experiment, that the point of suspension, with the wire and ball, may be rotated round an axis, passing along the length of the wire, without interfering with the vibration. In other words, the pendulum will continue to vibrate in the same plane, although the point of suspension be turned round the axis of suspension. It follows immediately from this that if we could suspend a pendulum at the north or south pole and set it vibrating it would continue to swing in the original plane of vibration; and as the earth is turning on its axis, a marked line on the earth's surface would appear to turn underneath the pendulum; or rather, it would seem to an observer, accustomed to feel as if the earth were at rest, that the plane in which the pendulum vibrates turns round relatively to the marked line on the earth's surface. It is easily shown that a similar phenomenon may be observed in any latitude except at the equator; the amount of rotation, however, that the plane of vibration of the pendulum seems to undergo is not so great in low latitudes as in high latitudes; but still in our latitudes rotation takes place to an extent easily observable. The performance of this experiment requires the greatest nicety. The pendulum is suspended on a fine wire, the support of the wire being constructed with great accuracy, so as not to interfere with the vibrations. The motion of the pendulum must be strictly confined to one plane; and, for that reason, in setting it to vibrate the bob is drawn aside and fastened by a silk thread, and when everything has come perfectly to rest the bob is released by burning the silk thread. During its subsequent motion it is protected from currents of air by glass screens. It need scarcely be remarked, however, that this experiment is nothing more than an illustration. Our knowledge of the rotation of the earth, drawn from astronomical considerations, cannot be strengthened by it. This experiment was first made public in 1851, when it was exhibited by M. Foucault before the Academy of Paris.

Foucaux, Marie Filon, mä-rē fē-lôṅ foo-kō, French author: b. 1842. She wrote several historical studies and works of fiction on the Empire and Restoration periods, among them: 'Les belles amies de M. de Talleyrand' (1880); and 'Une intrigante de la Restauration' (1888). Further publications by her include several volumes on Sanskrit literature under the pen-name "MARY SUMMER." Of these the most noteworthy is her 'Contes et legendes de l' Inde ancienne' (1878), crowned by the Academy.

Fouché, Joseph, zhō-zĕf foo-shā, DUKE OF OTRANTO, French politician and detective: b. Nantes 29 May 1763; d. Trieste 25 Dec. 1820. The Revolution, into which he entered with enthusiasm, found him teaching philosophy in Nantes; he became advocate, and was sent to the convention by the department of Loire-Inférieure. Here he was placed on the Committee for Public Education, voted for the death of the king, and was implicated, at least nominally, in the atrocities of the period. In 1793 he was sent to the department of Nièvre to enforce the law against such persons as had incurred suspicion. In 1794 he incurred the hatred of Robespierre, and thus had a strong stimulus to assist in his downfall. In August 1795, he was expelled from the convention, and kept a prisoner till the amnesty in October. In 1796 he communicated important information to the director Barras as to the designs of Babeuf and was rewarded in 1798 by being sent to Milan as ambassador to the Cisalpine republic. Here he labored with Gen. Brune to establish a second 18th Fructidor; both were in consequence recalled. He appeared in Paris in 1799, after Barras had gained the ascendency, and was appointed ambassador to Holland.

Shortly after Fouché was recalled and named minister of police. Here he first had full opportunity to display his great talents, and exercise an important influence on the interior policy of France. The situation gave him great power during the war. After the battle of Waterloo, Fouché urged Napoleon's second abdication, and advised him to seek an asylum in the United States. He placed himself at the head of the provisional government, negotiated the capitulation of Paris, obtained the removal of the army behind the Loire, and thus prevented useless bloodshed. Louis XVIII., whose return to the throne he had not at all supported, made him again minister of police; and it is to his credit that he labored so zealously in favor of moderate measures as to incur the hatred of all the ultra-royalists. He therefore resigned his office in 1815; and went as French ambassador to Dresden. As he was struck at by the decree issued in 1816 against the murderers of the king, he sought an asylum in Prague. He afterward went first to Lintz, and then to Trieste. It was Fouché who made the famous remark on the execution of the Duke of Enghien, of which he disapproved: «*C'est plus qu'un crime, c'est une faute*» (It is more than a crime; it is a blunder). Consult Martel, 'Etudes révolutionnaires: Etude sur Fouché' (1819).

Foucher, Jean, zhŏṅ foo-shā, early explorer and colonizer in South America: b. Cambrai, Flanders, 1508; d. 1567. He was with Sebastian Cabot at the discovery of the Paraguay River, in 1534 shipped as pilot to Mendoza's expedition to Paraguay, led an exploring party to the foothills of the Peruvian Cordilleras, and was a counselor of Cabeza de Vaca (q.v.), with whom he was sent prisoner to Spain. Having received pardon he was appointed governor of Entre Rios, where he maintained a friendly attitude toward the natives and made further explorations.

Fouchet, Jean Antoine Joseph, zhŏṅ äṅ-twän zhō-zĕf foo-shā, BARON, French diplomatist: b. St. Quentin, France, 1763. The date of his death is not known. He was a law student in Paris when the Revolution broke out and published a pamphlet in defense of its principles. Soon afterward he was appointed a member of the executive council of the Revolutionary government, and was French minister to the United States in 1794-5. Subsequently under Bonaparte he was prefect of Var and, in 1805, of Ain. On Napoleon's return from Elba he was made prefect of the Gironde.

Foucquet, Jean, zhŏṅ foo-kā, French painter: b. Tours about 1415; d. Paris about 1485. He received his early artistic training in Italy, where he painted a portrait of Pope Eugenius IV., and later entered the service of Louis XI. of France. For the king he executed several portraits. His best work consists of 40 miniatures in a prayer-book for Etienne Chevalier. Only in comparatively recent times has he been recognized as a founder of the French school.

Foula, foo'lạ, island, the most westerly of the Shetland group, lying 16 miles southwest of the nearest point of mainland. It is a little over 3 miles in length and is 2½ miles in breadth.

Foulis, fowlz, **Robert** and **Andrew,** Scottish printers: b. Glasgow, the former in 1707; d. 18 Sept. 1781; the latter in 1712; d. 178[illegible]. In 1739 Robert commenced business in Glasgow as a bookseller; and in 1742, having obtained the appointment of printer to the university, began in that capacity to issue editions of the ancient classics, which have made his press famous, both from the beauty of their type and their accuracy. In this latter respect one of his editions of Horace stands pre-eminent, and is hence known by the name of the 'Immaculate' edition.

Foulk, George C., American naval officer: b. Pennsylvania about 1860; d. Kioto, Japan, 1894. He was graduated from the United States Naval Academy, and after service on the Asiatic station, was withdrawn from naval duty to act as secretary and interpreter to the embassy of the Korean empire, the first sent by that country to a western nation. In 1884 he became naval attaché to the American legation at Seoul. He traveled widely in the country, and was influential in introducing many western methods and manners. Later he again served in the navy, and became professor in Doshisha University at Kioto, Japan.

Foulke, William Dudley, American author: b. New York 20 Nov. 1848. He was graduated at Columbia in 1869, at the Law School of the University in 1871, practised law in New York, removed to Indiana, and there became a member of the State Senate (1882-6). In 1889-90 as chairman of a special committee of the National Civil Service Reform League, he made important investigations in connection with the United States civil service. In 1893 he was chairman of the Suffrage Congress at the World's Columbian Exposition. His publications are: 'Slav or Saxon' (1887); 'Life of O. P. Norton' (1899); 'Moya' (1900).

Foundation. The term designates either the lower courses of a masonry structure, or a specially prepared surface or bed in contact with the soil or bed-rock upon which a structure of any kind is to be built. In practice there are many cases, however, in which the bed and the lower courses of the masonry structure jointly comprise the foundation proper, and render difficult or unnecessary the drawing of any marked distinction between them. Such combinations generally afford foundations of great permanency and strength, the most important qualities in connection with architectural and engineering works.

Oftentimes, in the erection of such works of great magnitude as well as those of lesser importance, the requisite care and attention are not devoted to the construction of the foundations, thus seriously impairing the integrity of the superstructure. This carelessness, however, appears to develop periodically; but, the errors of one period are naturally so fruitful of injurious results that they not only lead to the exercise of greater care during the period following, but stimulate the development and adoption of more scientific and skilful methods.

This is very clearly shown in the works constructed during the Roman Period. The earlier Romans erected their buildings on the most solid foundations constructed of large blocks of concrete, composed of quarry rubbish, gravel, or burnt earth, bonded by an excellent mortar. This material formed under the superstructures homogeneous basements of veritable artificial rocks capable of sustaining the heaviest of buildings without rupture or settlement. During the later Roman period, however, the foundations were much neglected, so that the architects of the 12th century were afforded so many examples of important edifices fallen on account of bad foundations, and for no other reason, that they were compelled to exercise greater care, and employ more skilful methods.

These remarks are especially applicable to the foundation methods practised at the present time. The architectural and engineering works of to-day have passed from the types of comparatively light superstructures to those of mammoth size and enormous weight, requiring the strongest and most permanent foundations that modern engineering skill is capable of designing, and the application of reinforced concrete or concrete steel methods to the construction of practically all classes of foundations appears to represent the best practice of modern times.

The employment of a particular type of foundation depends upon the character of the soil and the presence of water, and the widely varying conditions met with in practice have developed several classes of foundation structures which may be briefly designated as peat foundations, sand foundations, hard soil foundations, pile foundations, etc., which may be more intelligently described in the special paragraphs following a few very general but necessary remarks on foundation soils.

Foundation Soils.— These vary in character from hard and solid bed-rock, hard-pan, and firm sand to liquid mud, quicksand and silt. It is clear that hard bed-rock, hard-pan, firm sand, and various kinds of compact clays are the best materials to sustain foundation structures; but practical experience has very satisfactorily demonstrated that almost every substance in nature is capable of supporting the weight of any other substance, no matter how small the sustaining capacity of that material may be, provided the weight to be sustained is distributed over a sufficiently large area, and provided the conditions of the soil are permanent. Under any conditions, however, other than those obtaining in the case of solid rock, the adoption of the particular type of foundation requires the exercise of the highest order of forethought on the part of the constructing engineer in arranging for the proper distribution of the weight of the superstructure, and in providing means to counteract the injurious effects of any vibration to which it might possibly be subjected.

The sustaining power of soils depends upon their composition, the amount of water which they contain or which may drain through them, and the degree to which they are confined. Sound hard bed-rock of ledge formation will support loads up to 36 tons per square foot, but if the rock is seamy and rotten its sustaining capacity will be materially less, and will require special treatment in the construction of foundations thereon. In general, the composition of the different kinds of substrata varies so greatly that it is impossible to apply specific rules: but the latest practice assumes the following safe allowable pressures: For hard-pan, eight tons per square foot; compact sand and clean gravel free from lateral movement, five tons per square foot; dry clay, three tons per square foot; and loam, one ton per square foot Soft, watery clays, mud, quicksands, and silt have very little or no sustaining power, and have to be penetrated until firmer material is reached, and require to be compacted by draining, or consolidated by other means. If piles are employed, and they are driven to bed-rock or to refusal, the sustaining power is determined by the crushing strength of the material of the pile — timber, iron, or reinforced concrete, as the case may be.

Peat Soil Foundations.— In soils such as peat, it is almost impossible to carry the walls down to a sufficient depth to reach a solid base. In such cases one of three methods has to be adopted — to lay a strong concrete floor spread over a sufficient area; to use cylinders of iron or brick work; or to employ piles. If a concrete floor is employed, it should cover the entire surface to be occupied by the building, and should extend to some distance beyond the footings of the walls in order to prevent cracks and settlements. These injuries are usually caused by heavy walls being placed too close to the edge of the concrete floor, causing it to buckle and crack, and to settle irregularly under the unequal weights of walls of different thickness. This condition is somewhat obviated under the French system by forming a lip under the edge of the concrete floor, converting it into a kind of inverted tray which confines the substratum within its limits. The material of the foundation should be strong and homogeneous, while that of the superstructure should be of the coursed and bonded, or articulated, construction, so that if necessary it would yield slightly at the joints and thus accommodate itself without fracturing to any slight or unequal settlements during construction.

Sand Soil Foundations.— In hard stable sand or gravel, or in compact dry clay above water level, the construction of strong, permanent foundations require comparatively simple methods. If the location is in cold countries, the preliminary excavation is carried well below the frost line, and the bottom is carefully leveled off to receive the concrete bed, or the broad footing formed by the lower courses of the masonry.

In the case of compressible soils, artificial means in the form of piles, or of beds of concrete are first employed to reinforce the sustaining power of the substratum, and upon the platforms thus obtained the foundation proper is then constructed. On the other hand, if the foundations have to be constructed upon running sand, the greatest care and skill is required to prevent the work from being undermined by pumping out sand with the water during constructing operations. About the only way to handle such a case is to make a good concrete floor the entire width of the trench by putting it in as quickly as possible, sealing up the sides of the trench, and then pumping out the water when it reaches the level of the top of the concrete, and not from a sump. In building dock-wall upon running sand, the probable effects due to the cessation of pumping operations in the course of construction, require to be carefully considered. In such a case, the entering water will exert a varying pressure on the floor of the dock and the foundations of the walls according to the difference of tide levels on the outside of the dock.

Foundations for bridge piers on or across sand are usually constructed by sinking iron tubes or piles equipped with large disks or screw shoes at their lower ends, the diameters of which are regulated to support the weight intended to be placed upon them.

Clay Soil Foundations.— As in the case of sand and gravel free from lateral movement, the construction of foundations in dry clay calls for the application of the simplest methods; but, in clay strata impermeated with water, and having a tendency to slide, especially in the case of hillside excavations, the problem becomes more difficult and complex, and requires special methods for its successful solution. As a rule, such soils do not slide piecemeal, but move as a mass with an almost irresistible energy capable of rupturing the strongest timbers as if they were toothpicks. The only way to proceed in such cases is to disturb as small a section as possible at a time so that any forward impulse may not be communicated to the entire mass, and to provide strong cross walls in the basement to act as buttresses. The foundations should be carried down to or below the ultimate drainage level so as to prevent shrinkage by any subsequent draining of the subsoil which will lead to disastrous settlements.

Pile Foundations.— These consist of groups of piles of timber, iron, or concrete, plain or reinforced, sunk into the substrata and capped with platforms of timber or concrete upon which the superstructure is finally built.

Timber piles are tree trunks of varying diameter and length, with the bark removed and the knots and lateral branch stems cut off. Iron piles are of two kinds: the screw pile, consisting of a shaft of iron or wood, equipped at the foot with an iron casting in the form of two screw blades ranging in size from one to five feet in diameter; and the disk piles, consisting of hollow tubes carrying disks at their lower ends instead of screw blades. Concrete piles consist of cylinders of concrete formed in place, and of columns of reinforced concrete of rectangular cross-section made above ground and subsequently driven into place by means of a pile driver.

Various methods are employed to sink or drive piles into place. Timber piles are driven by the use of hammers which are raised and dropped by some form of engine developed power, and by the aid of jets of water under pressure, as suggested by Sir James Brunlees as early as 1850, and first employed by him in connection with the sinking of iron piles in the construction of the foundations to carry a railway across the treacherous sands of Morecambe Bay. Some of the most notable deep pile foundations constructed by the driving method are those under the new Public Library building, and the Illinois Central Railway passenger station in Chicago, Illinois. The passenger station consists of a structure 180 by 220 feet in plan, 9 stories high, with a tower 13 stories high, and a station 3 stories high connected with a train shed 680 feet long. Borings taken on the site showed the substrata to consist of ten to twenty feet of rubbish accumulated by dumping, and below that, several irregular layers of stiff blue clay and quicksand down to bed-rock, more than 60 feet below the surface. These conditions led to the adoption of a deep pile foundation, and about 1,700 piles, arranged in groups or clusters, were driven under the columns. These piles ranged in size from 40 to 60 feet in length, and from 11 to 16 inches in diameter at the butt. Thirty-two per cent were black gum, 22 per cent pine, 21 per cent oak, 7 per cent basswood, and 15 per cent hickory, with a few maple and elm. They were driven with drop hammers weighing 2,800, 3,200, and 3,800 pounds respectively, the fall ranging from 35 to 50 feet. A cast iron cap was fitted over the heads of the piles to prevent them from being crushed or split, but in spite of this protection over 8 per cent of the heads suffered serious injuries of that character. The piles were all driven in groups until the tops of all were below the leads, then the driving was completed by the use of a follower. Water was kept running continuously around the pile at the surface during the driving operations and was found to materially aid in the sinking of the piles. After the piles had been driven home, the tops were sawed off to a uniform height of three feet below datum, thus placing all the timber below low water level. As this was at least ten feet below the surface, the trenches had to be sheathed, and were kept drained by continual pumping. The earth was excavated to the depth of 18 inches below the top of the piles and rich Portland cement concrete was tamped in flush with the tops. Finally, oak caps 12 inches square were drift-bolted to the centre of each pile, and the space between the timbers was filled with concrete.

When piles are sunk with the aid of jets of water, the work is accomplished much more simply and rapidly than by driving. A pipe two or three inches in diameter is attached to the side of the pile and connected to a pump. The pile is first covered with pitch and then the water is forced through the pipe under the bottom of the pile, so that the sand is converted to a degree of fluidity that allows the pile to descend rapidly to the desired depth. When one pile has been put down home, the feed pipe is detached and spiked onto another and the operation is repeated. The accuracy and certainty of this method is so great, that it is a common practice to make the holes for the bolts in the piles before they are brought into position. After the pile is down and a reasonable length of time has been allowed for the churned up sand to subside, it recovers its solidity and grips the pile so tightly, that it is almost impossible to start it again.

When hollow iron piles are used, the water is conveyed through the centre of the tube under hydraulic pressure, disturbing the sand under the piles and allowing them to sink by their own weight to the proper depth. Upon withdrawing the pressure and stopping the flow of water, the sand returns to its former consistency and holds the pile stationary. Numerous valuable and interesting experiments show that the gripping power of quicksand is equivalent to a uniform supporting power of five tons per square foot, and that such sands possess this power at the depth of only a few feet below the surface, and, furthermore, that an increase in depth is not accompanied by a relative increase in the supporting power. Under favorable conditions the water jet method can be applied equally well to the sinking of cylinders and caissons.

Concrete piles have been used during a comparatively recent period, but their success has been so great that their development in the future promises to bring them into general use in the place of timber and iron piles. These piles, as previously mentioned, are either formed in place, or they are molded above ground. A great many methods have been suggested for forming the hole to contain the concrete when the pile is formed in place. One method consists in driving a double shell of metal into the ground and then withdrawing the inner shell, leaving the outer shell as a mold for the concrete. Another method, shown by Fig. 1, employs a single shell equipped with a concrete or a steel point. The shell is first driven to the desired depth and then withdrawn slowly and the space it occupied filled with concrete, the surface being kept at a sufficient depth below the end of the tube to maintain the head required to resist the pressure of the ground. Concrete piles used for underpinning are usually sunk with the aid of the water jet to a depth sufficient to reach firm strata, and the bottom of the excavation is enlarged by means of a spiral expanding device so as to form a base, as shown in Fig. 2.

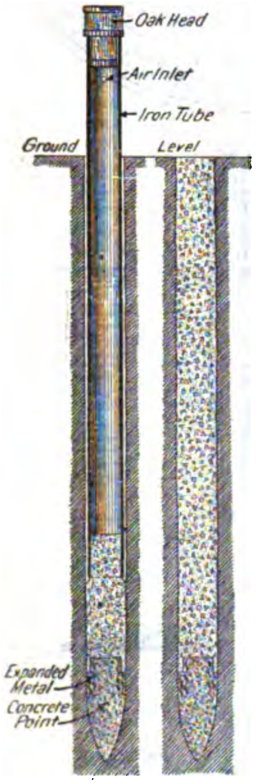


Fig. 1.

Piles made in place may be reinforced, if desired, but usually reinforced concrete piles are formed above ground. They are designed like columns, the reinforcement consisting of vertical bars of steel connected at intervals with horizontal wire rods or plates. Up to the present time they have been made only in square and triangular cross-section, circular molding being too expensive, and the arrangement of the required reinforcement being too complex. The general character of these piles is illustrated by Fig. 3, which shows the construction of the piles designed (but not used) for the foundations of the Hallenbeck building, New York city.

The supporting power of piles depends upon their action as a column resting on a hard base, or upon the friction against their sides developed by the gripping action of the material through which they have been driven. Very often the supporting power is a combination of both actions. The amount of this power may be calculated in various ways, but at their best the results are of necessity only approximations. The supporting power of a pile driven to bed-rock is determined by the crushing strength of the material of which it consists but if it is supported wholly or in part by friction, its supporting power is calculated by a formula based upon factors obtained by experiment, or upon the distance penetrated by the pile under the blow of the driving hammer. A formula based upon the last named factor and commonly used for determining the safe loading on piles is given by the expression:—

$$P = \frac{2Wh}{p + 1},$$

in which P = safe loading in tons upon a pile, W = weight of hammer in tons, h = height of fall in feet, and p = penetration in inches under last blow.

The construction of the pile foundations for the Chicago Public Library building afforded valuable information relative to the supporting power of piles as determined under actual conditions. Piles of Norway pine were driven with a steam hammer having a total weight of 8,300 pounds, the hammer alone weighing 4,500 pounds and delivering 54 blows per minute, with a stroke of 42 inches. The last 20 feet of driving was accomplished by means of a follower. The piles were placed about two and one-half feet centre to centre and the supporting power of four piles was tested by building a platform on top of them and loading it with pig-iron. Levels were carefully taken on each pile. They stood four days with a loading of six tons on each pile, eight days with a loading of 37 tons per pile, and 10 days with a load of 50 tons

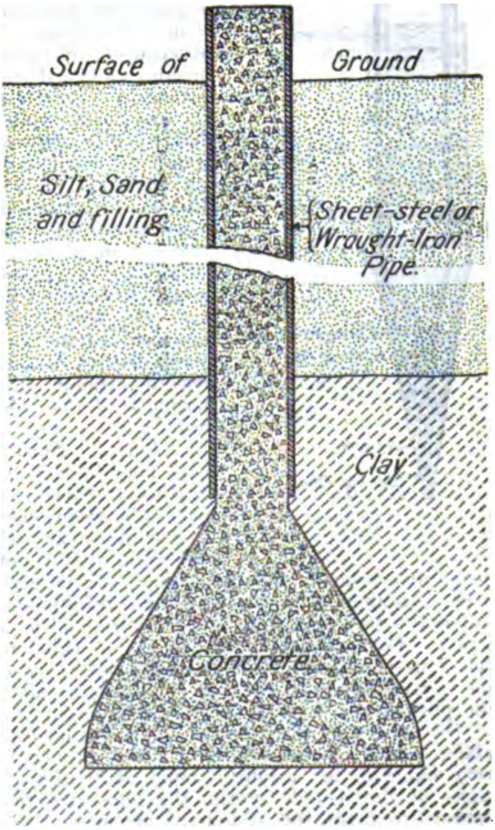


Fig. 2.

per pile. The settlement did not exceed 0.01 of a foot. These tests indicate that if 250 pounds per square inch be assumed for point resistance, the average frictional resistance will amount to about 3.2 pounds per square inch of side surface of pile, or about 432 pounds per square foot. In the case of an ordinary pile, seven inches through the top and 14 inches at the butt, driven to a depth of 45 feet, the point resistance would be 6,000 pounds, and the frictional resistance 59,000 pounds, a total earth resistance of 65,000 pounds, equivalent to the supporting power of the pile considered as a column, and allowing a factor of safety of 3 to 4.

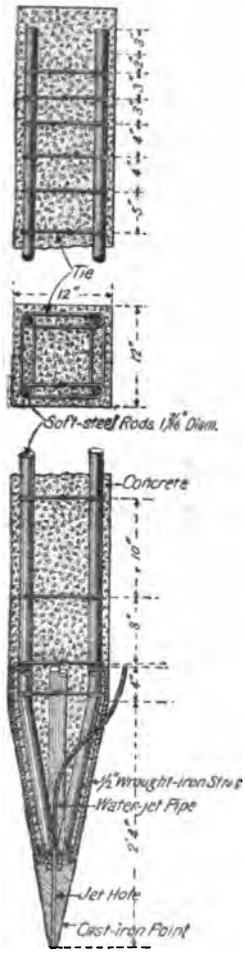


Fig. 3.

Usually, the determination of the point at which a pile is considered as having been driven to a firm bearing depends greatly upon the judgment of the engineer in charge, based upon his experience in the particular locality in which the work is being performed. The best practice, however, affords the following safe specifications of allowable penetration. For piles meeting a hard resistance a penetration of one inch under the blows of a 2,000-pound hammer falling 10 feet, and for piles held by friction, a penetration of three inches under the blows of a 2,000-pound hammer falling 15 feet. The minimum distance between centres usually depends upon the hardness of the substrata and the size of the butts. Spruce piles may be advantageously driven 24 inches between centres, while large and long piles ought not to be driven closer than 30 inches between centres. Another factor that must be carefully considered is the supporting power of the soil as a whole. For example, if that power is equal to two tons per square foot, and each pile is capable of sustaining 18 tons, it is useless to place the piles closer than three feet between centres.

In connection with the use of timber piles in places where the durability of the timber is very liable to be seriously impaired by the attacks of the Teredo worm, the latest practice appears to favor the system of armoring them with concrete. In such cases the timber piles are usually driven in sets of three to a firm bearing. They are then cut off, one two feet, one four feet, and one eight feet, below the level of the wharf platform. A wooden stave cylinder of three-inch planking is then placed around the piles and driven into the mud to a depth of 12 feet, and the bottom of the cylinder sealed. The contained water is then pumped out, and a cylinder of expanded metal is set within the wooden cylinder, and the remaining

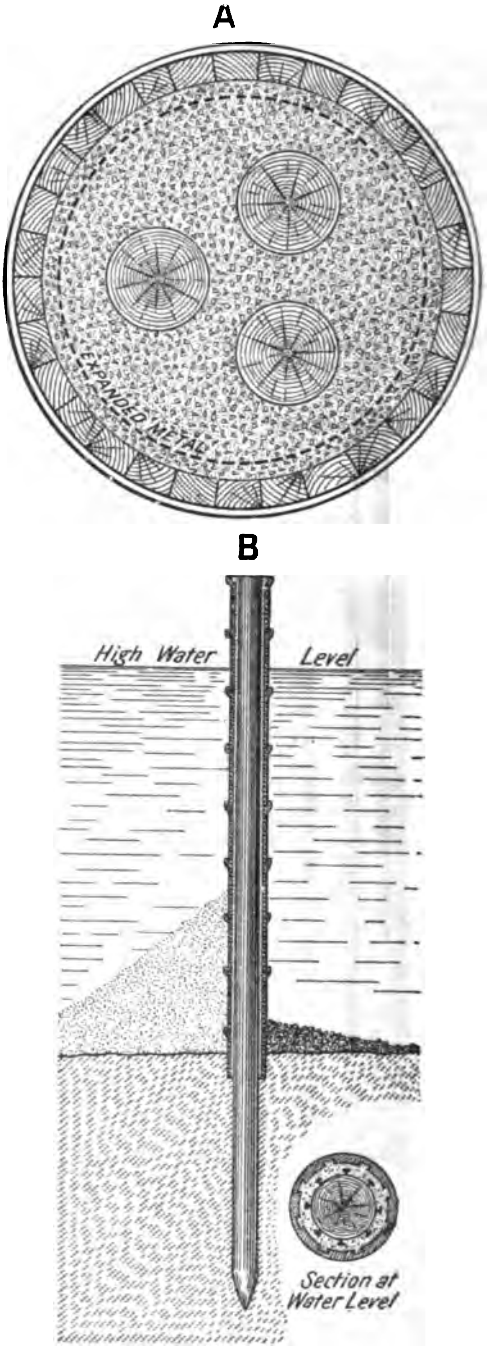


Fig. 4.

space filled with concrete. Diagram A, Fig. 4, illustrates this protective method as employed in wharf construction on the Pacific coast.

Another method still more recently introduced consists in the use of terra-cotta pipes as an outer covering for the piles. In this case the armoring is limited to individual piles. Before driving the pile, large-headed nails are driven into the surface of the wood near the level of the water line. The pile is then driven into place and the sections of terra-cotta pipe placed around it. The annular space of about two inches between the inner surface of the pipe and the pile is then filled with concrete. The method is especially applicable to works along the coasts of the South Atlantic and Gulf States, where there are no ice fields to contend with, and where no strong tidal and river currents necessitate the use of heavy masses of stone to protect the piles from the great force thereby exerted against them. This method is illustrated by diagram B, Fig. 4.

Platform Foundations.— These structures are designed to distribute a concentrated weight over a large area in soft substrata when piles are not employed. They may consist of beds of concrete, or of masonry or brick arches sprung between supporting piers or columns, as shown by Fig. 5. They may also consist of platforms of timber grillage — timbers placed across each other in alternate layers, or of platforms of concrete or masonry reinforced with a grillage of steel bars, as illustrated by Fig. 6, which shows the platform foundations of a World's Fair building in Chicago, consisting of a concrete bed reinforced with a steel rail and I-beam grillage, to support the base castings of the main columns.

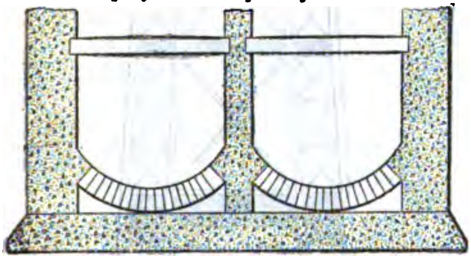
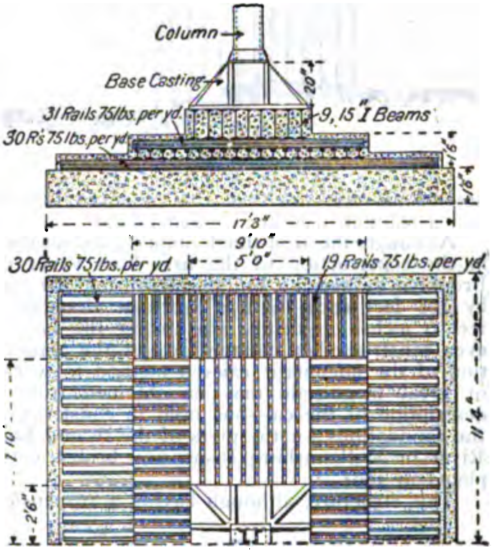


Fig. 5.

Subaqueous Foundations are those constructed in the substrata of river beds or other bodies of water, or where the existing conditions necessitate the building of structures in water and below the level of its surface. This class of work is accomplished by the use of cofferdams, cribs and open caissons, pneumatic caissons, by dredging through wells, by forcing cement into the substrata under pneumatic pressure, and by freezing the substrata.

Cofferdam Method.— The use of cofferdams is limited to the construction of foundations in shallow waters where the depth of the necessary excavation to reach a firm bearing is small, or in water bearing substrata on land. They are usually constructed by driving a double row of sheet piles — heavy timber planking — around the area in which the foundation is to be built. The space between the piles is then tamped in solidly with clay, and the water pumped out of the enclosure, so that the work of excavating and the subsequent masonry construction may be carried on in the open air. Cofferdams are sometimes constructed of walls composed of bags of clay piled around the foundation area, and reinforced with barrels of sand banked on the outer side of the walls.

Crib and Open Caisson Method. Under this method, the foundation bed is first prepared by dredging until a solid material is reached, or by driving piles to a sufficient depth to reach a firm bearing. When piles are employed they are cut off at a uniform depth below the level of the water surface and constitute the supporting bed of the caisson. The caisson consists of a water-tight box-like structure open at the top. It is floated over the position of the bed, previously prepared by dredging, and the masonry work built up in its interior until it gradually sinks and rests upon the bed. The side walls are then removed, leaving the bottom of the structure — the crib — in the foundation between the masonry and the supporting bed. Fig. 7 illustrates the foundation for a pier constructed by this method, the crib being supported by piles.



Sectional Elevation

Half Length Plan

Fig. 6.

Pneumatic Caisson Method.— In this method two water-tight box-like structures built of timber or of metal are used. They are connected together one above the other, the lower caisson being inverted, that is placed bottom up, and the upper one open at the top. This structure is floated and anchored over the position selected for the pier and the masonry built inside the upper caisson until the lower edge of the lower caisson rests on the bed of the body of water. The contained water in the lower caisson is then expelled by compressed air, allowing men to enter and excavate the underlying material within the limits of the caisson. As the excavated material is discharged by being passed out through the top of the caisson, and the masonry work is added to course by course, thus keeping it always above the surface of the water, the caisson sinks lower and lower into the substrata until it reaches solid rock or other firm material. The lower caisson is then filled with concrete, and the sides of the upper caisson are removed, leaving the masonry on the foundation formed by the lower caisson with its concrete filling. Fig. 8 shows the longitudinal section of a caisson of this type.

The pneumatic method, although one of the most effective, is limited in its application to work at a depth of about 100 feet below the surface of the water, as it is impossible for men to work conveniently and effectively under a greater air pressure than that required to sustain a column of water of that height.

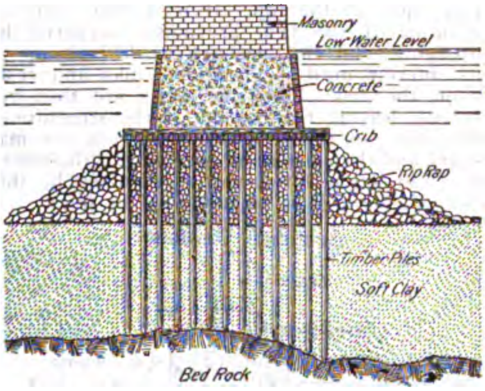


Fig. 7.

Although the iron-lined timber caissons used in the construction of the first East River or Brooklyn suspension bridge, measuring 102 feet by 168 feet each, with a working chamber 9 feet 6 inches in depth, are among the largest ever constructed, a clearer idea of the application of the pneumatic caisson method to works of great magnitude may be obtained from a description of the caissons used in constructing the foundations for the piers of the second East River or Williamsburg suspension bridge, completed in 1904.

This structure, although having a suspension span the same length as that of the older bridge, is of much greater magnitude in many other ways. Each of its two steel towers is supported by two piers, as shown by Fig. 9. The following description is that of the north caisson of the New York tower, but it also applies in almost every particular to the other three. As determined by borings, the bed consisted principally of sand, and some clay and boulders. Below this, at a depth varying from 45 to 75 feet below high water level, the formation consisted of gneiss rock with a very irregular surface. The caisson was sunk through the sand, clay and boulders until it rested on the rock, which was then blasted away and stepped so as to make a fair bearing for the edge on all sides. The caisson measured 60 feet by 76 feet on the sides, with a total depth of 19 feet, and a working chamber 7½ feet in height. The walls were two feet nine inches thick and were built of two courses of 12 by 12-inch timbers, the outer course placed longitudinally and the inner vertically. Two layers of 3-inch planking were placed on the outside, and one layer on the inside. The bottom of the walls was provided with a cutting edge, as shown by Fig. 10, which extended continuously around the whole caisson. This cutting edge was constructed of ½-inch steel plates, stiffened at intervals of 2½ feet of its length by knee braces. It extended two feet below the bottom of the lowermost timbers, and the lower 12 inches were stiffened with reinforcing plates, so that it had a total thickness of two inches. The cutting edge was not provided for the purpose of cutting through the bed of the river, but to enable the workmen to use their tools close to the outer edge of the walls of the caisson, which were nearly three feet in thickness, and also to facilitate the removal of obstacles, such as boulders, which could be dis-

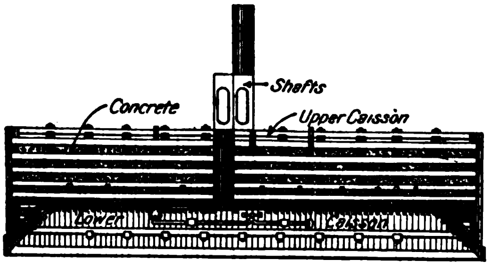


Fig. 8.

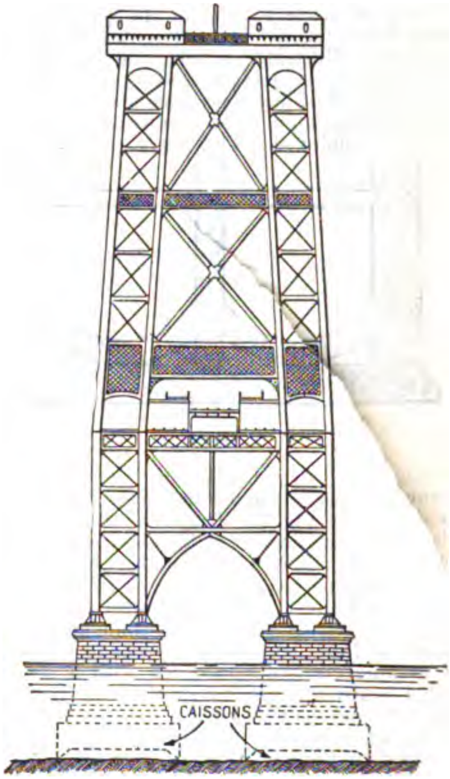


Fig. 9.

lodged with less difficulty from underneath the two-inch edge than the bottom of the three-foot wall. The roof of the working chamber was five feet in thickness, and consisted of several layers of 12 by 12-inch timbers laid alternately crosswise and covered with alternate courses of 3-inch planks laid diagonally. The roof, and in fact the whole caisson, was stiffened with eight massive steel-plate riveted-trusses, which extended across from wall to wall. All the timbers of the caisson and of the roof were drift-bolted together so as to give great rigidity to the structure, and to make it perfectly water-tight. Additional strength was given to the working chamber by two solid bulkheads, which extended entirely across and divided it into three compartments, openings being provided for the passage of workmen. A massive framework or gridiron formed of 16 by 16-inch timbers was bolted together and to the side walls at the level of the lowermost timbers with 1½-inch steel tie-rods. From each intersection of this framework vertical posts reached to the roof and were tied together and stiffened to resist lateral distortion, by diagonal struts and tie-rods, as shown in Fig. 11, practically forming two steel trusses nine feet three inches in depth, with a weight of 10 tons each. They were a novel feature in this class of work, but were rendered necessary on account of the shallowness of the caisson. The roof was pierced with seven shafts, each about three feet in diameter, for the passage of men and material, and several pipes ranging from one to five inches in diameter, for supplying air and water, blowing-out sand, and for carrying electric light wires. These shafts were of circular section, and were put in place in lengths of eight feet as the masonry work was carried upwards.

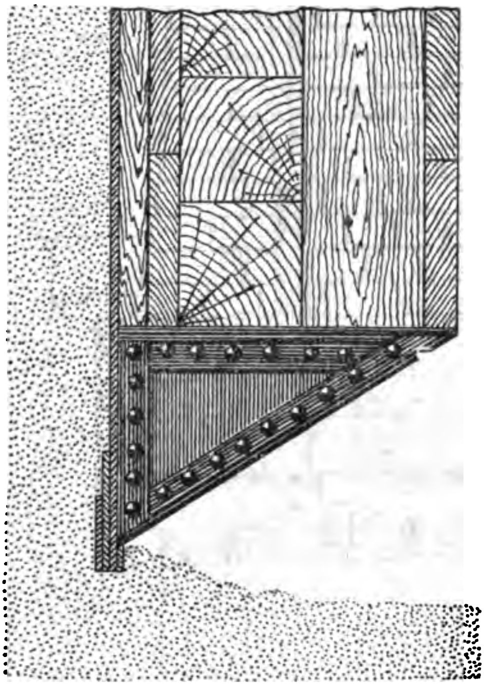


Fig. 10.

The piers on the Brooklyn side were constructed in a similar manner, with the exception that they were carried to a depth of 107 feet below high water. The last caisson to be sunk passed through 50 feet of water, 20 feet of sand, gravel and boulders, 30 feet of hard clay and hard-pan, and 12 feet of rock. The excavating of the rock was rendered necessary by the steepness of its slope.

The lower caisson measured 63 feet by 79 feet, and contained 74,700 cubic feet of timber, and 98 tons of iron, the greater portion of which was in the form of drift-bolts. Without the concrete filling it weighed 1,965 tons, and contained 6,000 yards of concrete above the roof of the working chamber. The upper caisson was 50 feet deep and contained 29,000 cubic feet of timber, and 32 tons of iron.

The sinking and concreting was accomplished in three months and six days, a very rapid piece of work considering the great depth to which the caisson was sunk. Down to the depth of 55 feet the men worked in eight-hour shifts. Below this depth the shifts were successively shortened as greater depths were attained. From 55 to 70 feet the shifts were six hours long; from 70 to 80 feet, four hours; from 80 to 90 feet, two hours; from 90 to 100 feet, one and one-half hours, and from 100 to 107 feet, 45 minutes. The pay of the men was increased in proportion to the depth at which they worked, and ranged from $2.50 for the eight-hour shift to $3.75 for the short shifts at the lowest levels. Although the air pressure at the depth of 107 feet was 46 pounds per square inch, there was very little sickness among the workmen, and only one serious case. The piers above the caisson foundation were built of limestone masonry up to low-water level, and, above that, of limestone with a granite facing.

Other notable examples of the pneumatic caisson method, both in the United States and in foreign countries, are the foundations of the centre pier of the Harlem River bridge, New York city; the Benares bridge over the Ganges River, India; the Poughkeepsie bridge over the Hudson River, New York; the Hawkesbury bridge, New South Wales, Australia; and the Jubilee bridge over the Hooghly River in Bengal. The centre pier of the Harlem River bridge supports the thrust of a 510-foot steel arch on each side of it, and stands on a timber caisson 54 feet by 104 feet, with a depth of 13 feet. It is divided into three compartments by vertical partitions, which not only served to strengthen the caisson, but protected the men during the blasting operations necessitated by the greatly inclined surface of the rock.

Foundations for piers or abutments of bridges, or for the main columns of high buildings, where the individual piece of work is of lesser magnitude than those already cited, are usually constructed by the use of cylinders of iron, as illustrated by Fig. 12. The arrangement consists of a cylinder of metal divided into two unequal parts by a horizontal partition — the upper and larger part, essentially a coffer-dam, being the caisson proper, and the lower part within which the excavating operations are carried on being the working chamber. It is provided with one or two shafts made of boiler-plate, which are connected with the air chamber on top adjoining the equilibrium chamber or air-lock through which the workmen and materials must enter. A pipe from the air compressor furnishes the air chamber with compressed air, which is subsequently introduced by a system of locks to the working chamber below.

Dredging in Wells.— Beyond the limit of the effective application of pneumatic methods, about 100 feet below the water surface, all excavating must be accomplished by dredging, and special care has to be exercised in planning the method of operations to prevent any contingency arising at the bottom that would require to be dealt with by the use of human labor, as diving operations are impossible. It is also important to observe that the skin friction, quite unimportant in a cylinder of moderate depth, becomes so great at lower levels that special means have to be employed to overcome it. In the Benares bridge mentioned in the foregoing paragraphs, the principal piers are sunk to the depth of 140 feet below the level of the water, and consist of oval brick wells each 28 feet by 65 feet in diameter, the bottom lengths being cased, in iron, as it was necessary to begin operations in the water. Each well is divided into three vertical compartments in which the dredging was carried on. In constructing the Poughkeepsie and the Hawkesbury bridges, almost identical methods were employed. In the case of the former, the caisson is of timber; it measures 60 feet by 160 feet, with a depth of 125 feet. It is divided into 40 vertical cells, and was sunk to a depth of 130 feet by filling in some of the cells and excavating in others. In the case of the latter, the caisson is of steel and iron, of oval form, 20 feet by 48 feet diameters, and splayed out at the bottom an additional two feet all around. It is divided into three dredging wells set on the centre line and parallel to its length. They splay out at the bottom so as to meet each other and the outer skin, thus forming a cutting edge. It was sunk to a depth of 161 feet below the water level by dredging in the wells, and by filling the space between the wells and the outer skin with concrete. This is probably the greatest depth ever reached in the construction of a bridge foundation.

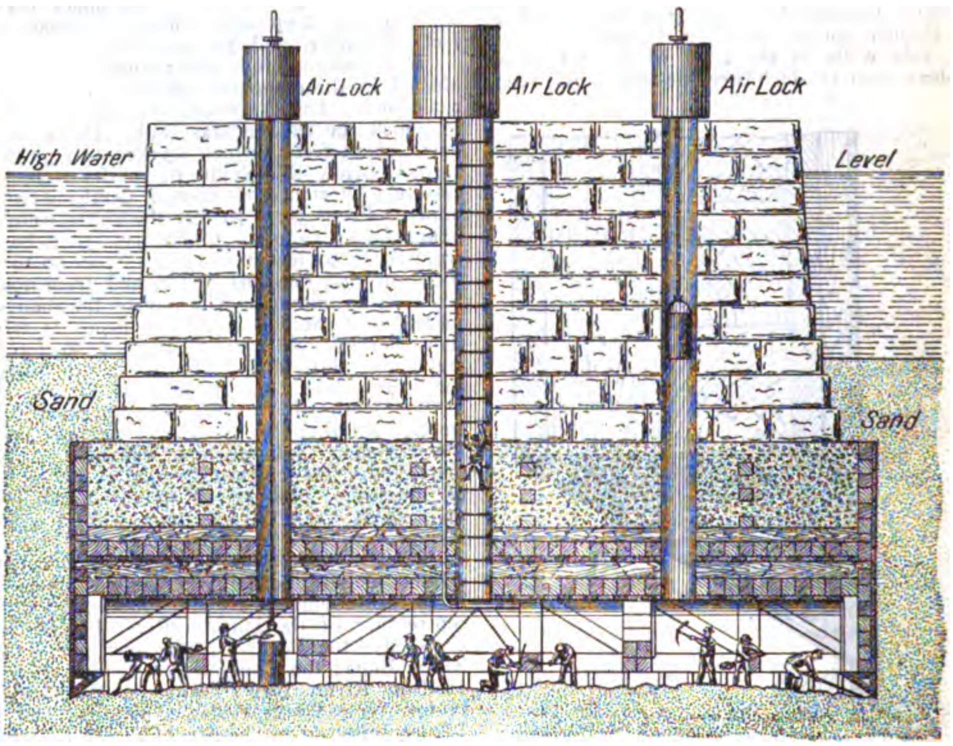


Fig. 11.

The foundations of the piers of the Hooghly bridge were constructed by the use of similar caissons. The outer skin of the caisson, however, is entirely vertical, and the three dredging wells extend right across the structure, occupying the semicircular ends and the central portion. The weight for sinking was obtained by filling the two 15-foot intermediate spaces with concrete, and by placing a brick lining around the semicircular ends. It will be understood that in all these cases the dredging wells were finally filled up with concrete when the proper depth was reached.

Pneumatic Forcing Method.— This is an improved method of constructing subaqueous foundations in sand or gravel substrata by converting it into a solid in the form of sand or gravel concrete. This is effected in place, without excavating operations, by forcing cement in the form of the dry powder in which it is furnished commercially, through a pipe by air pressure into the substrata. The charging pipe, called the lance pipe, has an internal diameter of 1½ inches, and is drawn to a point at the lower end, and perforated with three or more holes ⅜ of an inch in diameter. The upper end of the pipe is connected by means of a bend and rubber tubing with the air pressure supply pipe, suitable arrangements being provided to raise, lower, or move it while in operation. The air pressure supply pipe is provided with suitable branches fitted with stop-cocks to permit of its being connected to an injector device by which any desired quantity of cement powder may be fed into the current of air. In operation, the air pressure forces the cement powder through the small openings at the lower end of the lance pipe and drives it into the substrata of wet sand or gravel, with which it combines and forms sand or gravel concrete as the case may be. The lance tube may be sunk to depths of 16 or 19 feet in a comparatively short time, and in order to insure a uniform mixture in the foundation pit, the foundation area is divided into small fields 8 to 12 inches square, into each of which the proper quantity of cement is blown. The proper amount of the cement charge is determined by dividing the cubic contents of the field by the required proportion of the mixture. Usually, the saturation of the sand is so thoroughly accomplished that when the forcing operations are discontinued, the particles of sand, if allowed to come together, would adhere to each other with a great deal of energy, so much so that it is well known to all makers of concrete, whether by hand, mixer, or mill methods, that the volume of the resulting material is always less than the sum of the volumes of the ingredients in their free and uncombined state. Experience has demonstrated that the best proportions of the two ingredients are one part by volume of cement to five parts of sand, or sand and gravel, measured in the same manner. This method was first suggested by Fr. Neukirch, of Bremen, Germany, and is being extensively used in various ways other than the construction of foundations proper, for such purposes as the consolidation of the soil around brick sewers, in the building of quay-walls, and in many other cases where the driving of cofferdams would be dangerous or impracticable.

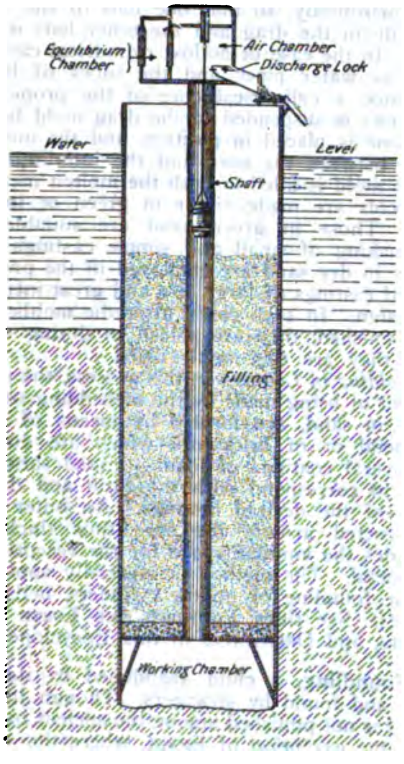


FIG. 12.

Another method by which bodies of cement or concrete may be placed in quicksand substrata employs pipes in the following manner: Two or more iron pipes are sunk through the quicksands to the desired depth, and water pumped into one of the pipes, thus converting the substrata into a condition of fluidity sufficient for the purpose of pumping it out through the other pipe. The cement is then introduced through the forcing pipe and filled into the agitated area at the bottom of the pipes.

Freezing Method.— This method is employed in the construction of subaqueous foundations, or of foundations in quicksand, or in soft water-bearing substrata, where the fluidity or lack of plasticity of the soil requires it to be artificially consolidated before excavating work can be instituted therein. In the Poetsch process, a large number of pipes are distributed as uniformly as the unstable conditions will permit, and are then filled with a strong freezing liquid which is maintained in a state of constant and active circulation until the substrata becomes solidly frozen. The excavation is then made in the frozen material, and the foundation put in and allowed to set firmly, after which the freezing operations are discontinued and the substrata allowed to thaw and assume its normal condition around the work. The method is not one that bears recommendation for works of magnitude. The thawing sands usually return to a state of unstable equilibrium not very conducive to the permanency and stability of the structures built therein, and besides that, the cost of the refrigerating plant, together with the accessory machinery and appliances, is so excessive as to be practically prohibitory in ordinary cases. It may be advantageously applied, however, in many special cases, especially in the construction of subaqueous tunnels and for making repairs to all classes of subaqueous structures.

Bibliography.— For further information consult: Baker, 'A Treatise on Masonry Construction' (New York, 1900); Buell and Hall 'Reinforced Concrete' (New York, 1904); Fowler, 'The Cofferdam Process for Piers' (New York, 1898); Patton, 'A Practical Treatise on Foundations' (New York, 1893); Taylor and Thompson, 'Concrete, Plain and Reinforced' (New York, 1905); and special articles on the subject in the various engineering magazines and periodicals.

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Founder, also called **Laminitis,** consists of inflammation of the vascular sensitive laminæ of the horse's foot Occasionally the laminæ are strained from severe exertion; more frequently they suffer from the morbid effects of cold, which is especially injurious after excitement and over-fatigue. The shoes must at once be removed, and the toes, if long, reduced, but no further rasping or cutting is permissible. The feet must be enveloped in hot bran poultices, and kept off the hard ground by a plentiful supply of short litter. Purgatives, if required, must be used with extreme caution. See HORSE, DISEASES AND CARE OF.— *Care of the Feet.*

Founders and Patriots of America, The, a society founded in 1896, and incorporated 18 March, of the same year, the object stated in the articles of incorporation being «to bring together and associate congenial men whose ancestors struggled together for life and liberty, home and happiness, in the land when it was a new and unknown country, and whose line of descent from them comes through patriots who sustained the colonies in the struggle for independence in the Revolutionary War; to teach reverent regard for the names and history, character and perseverence, deeds and heroism, of the founders of this country and their patriot descendants; to teach that the purpose of the founders could have had no lasting result but for their patriot sons; to inculcate patriotism; to discover, collect, and preserve records, documents, manuscripts, monuments, and history relating to the first colonists and their ancestors and their descendants, and to commemorate and celebrate events in the history of the colonies and the republic.» The order admits to membership any male citizen of the United States above the age of 21 years who is lineally descended, in the male line of either parent, from an ancestor who settled in any of the colonies prior to 13 May 1657, and whose intermediate ancestors in the same line during the Revolutionary period adhered as patriots to the cause of the colonies.

Founding. The art of making molds in sand, loam, or plaster of Paris, with or without the aid of patterns. The molds thus made are filled with molten metal which is subsequently allowed to cool and solidify into a metal casting corresponding to the form of the mold.

The various founding processes are characterized by the kinds of metal employed in the castings, such as iron, steel, brass, bronze, etc., and by the class of work produced, such as water pipes, car-wheels, ordnance, statues, bells, etc., involving the applications of special methods in the work of molding; in the melting of the metal; in the filling of the mold with the molten metal; and in the manner in which the metal is allowed to cool.

Molding in Sand.— The process of molding in sand by means of patterns embedded in flasks containing sand, is substantially as follows: The flasks, which are box-like arrangements provided with suitable handles by which they may be lifted and moved around, are generally used in pairs — the upper flask being commonly designated the «cope,» and the lower one, the «drag» or «swivel.» The patterns, usually of wood, are made either in one piece when the design of the casting is simple, or in several pieces when the form of the casting is more complicated. In molding, the drag is filled with sand and the pattern embedded in it. The cope is then placed over the drag and the sand rammed in tightly around the pattern. The pair of flasks is then turned over and the loose sand taken out of the drag and replaced by sand firmly rammed in its place. The flasks are now returned to their original position; the cope is taken off and the pattern removed. The cope is then replaced upon the drag, and the mold is thus made ready to receive its filling of molten metal. This is accomplished by pouring the metal through suitably formed gates or holes which extend through the cope and connect with the molded spaces in the drag.

The use of a separate appliance for a drag is very often dispensed with, the pattern being embedded in a bed of sand upon the foundry floor. This method is especially applicable when a large number of small castings are made at each pouring. Also, very often the patterns are made in two parts, that is, divided in the middle horizontally, so that one half of the mold is made in the drag and the other half in the cope. In the case of hollow cylindrical castings such as water pipes and the tubes of heavy ordnance, a cylindrical core of the proper dimensions is suspended in the drag mold before the cope is placed in position, and the annular space between the core and the interior walls of the mold is filled in with the molten metal.

Molds are made either in green or in dry sand. Those in green sand are suitable for the making of small and simple castings; but molds in dry sand are employed in the production of castings of large size and great intricacy of design. In such cases, after the molds have been finished, they are placed in drying ovens until they are thoroughly dried.

Molding in Loam.— In this process, the molds instead of being made by the embedding of patterns in sand, are formed by means of cores of metal or of brickwork which are covered by several coatings of loam — mixed sand and clay, to correspond with the form and dimensions of the desired castings. An outer shell constructed around the core thus thickened, provides the annular space for the reception of the metal. The method is especially applicable to the founding of hollow cylinders, bells, and statues. See titles FOUNDRY AND FORGE SHOP TERMS, and ORDNANCE, in this Encyclopedia.

Foundling, a child abandoned by its parents, and found by strangers. Though infanticide was not punished among the ancient nations, with the exception of Egypt, where the child's corpse was fastened to the guilty parent's neck for three days and nights, yet natural feeling would prompt parents to expose their offspring, and leave their fate to accident rather than kill them. They usually selected places which were much frequented, where there was a greater chance of the child being saved. In Athens and Rome they were exposed in especially appointed places. In the 4th century under the Emperors Valentinian, Valerius, and Gratian, the practice was prohibited. The Bishop of Treves in the 6th century allowed foundlings to be placed in a marble basin in front of the cathedral, thus entrusting them to the care of the Church.

In 787 a foundling hospital was established at Milan; one was established at Paris in 1362, but among the most famous of modern institutions is the foundling hospital in Paris formally established in 1670. It receives not only foundlings strictly so called, that is, deserted children of unknown parentage, but also deserted children of known parents, and destitute children generally, as well as children pronounced incorrigible by the courts or declared to be so by their parents.

England has no foundling hospital properly so called; all exposed children are brought up at the expense of the parish in which they are found. The Foundling Hospital in London, established by Thomas Coram, a master-mariner, in 1739, was originally a hospital for exposed and deserted children. It was for a time extremely popular, and was repeatedly assisted by parliamentary grants; but the enormous increase of abandonments, and the expense which they occasioned, produced such an alteration in public opinion that the hospital was changed to what it now is, a hospital for poor illegitimate children whose mothers are known.

In the United States foundlings are usually consigned to the county poor farm, but Foundling and Maternity Hospitals exist in the principal cities. Foundling hospitals are said to diminish not only the exposing of children, but also to render infanticide and intentional abortion less frequent. The objection that they contribute to the corruption of morals, if they receive children indiscriminately, and that they encourage parents to rid themselves of responsibility, is the strongest which can be urged against such institutions, and is not easily answered. In Massachusetts foundling hospitals are legally forbidden. In New York city foundlings are sent to Bellevue Hospital, and formerly were transferred to the Infants' Hospital on Randall's Island or in the borough of Brooklyn, to Flatbush. The rate of mortality among them was alarming; in 1897 all children received at the Randall Island institution died before reaching the age of two years, chiefly owing to the change of food and neglect before and exposure during abandonment. At baby farms, private institutions where babies were boarded for gain, the same conditions also prevailed. The attempt to remedy these deplorable conditions has met with great success since 1899. The work is supervised by the Joint Committee on the Care of Motherless Infants under the control of the State Charities Aid Association and the New York Association for Improving the Condition of the Poor, and their fifth annual report for the year 1903 shows the rate of mortality has decreased to 11 per cent as compared with 55.9 per cent in 1899, the first year of their work. Foundlings of whose parentage nothing is known are baptized alternately Roman Catholic and Protestant, the Roman Catholic children being in charge of the Guild of the Infant Saviour, while the committee care for the Protestants. In connection with this admirable work is an agency for providing situations in the country for destitute mothers with infants. The *mothering* system has been long enforced in the Chicago Foundling Asylum, and is being adopted in similar institutions throughout the States. Consult: Folks, 'Care of Neglected and Dependent Children' (1901); 'Reports of the Joint Committee on the Care of Motherless Infants'; 'New York Association for Improving the Condition of the Poor' (1903).

Foundry and Forge Shop Terms. The following list of terms includes some of the most significant words and phrases commonly used in connection with foundry and forge shop operations.

Angles.— Strengthening pieces which run around the angular portions of castings.

Annealing.— The subjection of brittle and non-elastic metals to the action of long continued heat, which effects a rearrangement of the ultimate molecules, and makes the metal tougher or more homogeneous. Steel castings, old chains and rods, and other forms of hammered work, which have been used for a long time, are improved by annealing; but, newly rolled plates and bars, the fibrous condition of which has not deteriorated, are weakened in tensile strength by the process. Annealing is carried on by means of "annealing-ovens" into which the "annealing-pots" containing the articles which require to be annealed are run, and exposed to the action of the heat for periods ranging from several hours to several days as the circumstances may require. The function of the annealing-pots is the preservation of the contained articles from the action of the atmosphere during the process of annealing.

Bars.— The stays or bridges placed in molding boxes to support the sand which encloses the pattern. They are purposely cast as rough as possible in order to insure the adherence of the sand. Vertical or "cope-bars" have their edges kept about three-quarters of an inch away from the pattern and about the same distance from the joint of the box. "Flat-bars" or "drag-bars" are placed in the "drag" or bottom-half of the mold, and therefore, do not follow the outline of the pattern.

Battering-off.— The finishing of the surfaces of forged work by hammering while the metal is dropping to a low red or black heat.

Bead Slickers or Bead Tools.— Sleeking tools used by molders for smoothing the impressions of beaded work such as the ornamental fillet or strip curved around the edge of a casting.

Bedding-in.— The method of molding in which the pattern is embedded in a bed of sand on the foundry floor instead of being placed in a box mold and "rammed-up" with sand.

Binders.— Rosin, glue, wheat and rye flour, linseed oil, etc., employed for the purpose of giving strength to "core-mixtures."

Blackening.— Pulverized charcoal, coal, coke, and plumbago or graphite used by molders for sleeking over the surface of a mold in order to prevent the castings from becoming "sand-burnt."

Black Wash.— A solution used on loam-molds and dry-sand molds for the same purpose that blackening is used in green-sand molds.

Blast.— The volume of air artificially forced into furnaces and forges by means of bellows, blowers, and rotary fans, to accelerate the combustion.

Blowers.— Machines employed for the production of blast, ventilation, etc. The principal forms consist of blowing cylinders and pistons, and the rotary blowers or centrifugal fans which are operated by power driven belting. Ordinarily they deliver a blast ranging from four to six ounces, approximating to a pressure ranging from seven to ten inches as indicated by the water gauge.

Blowholes.— Hollow cavities in castings caused by the presence of bubbles of air, or gas in the mold due to imperfect venting. When of a bluish color, they indicate the presence of sulphur in the metal.

Bottom Board.— The board on which the joint of a pattern is placed when it is being rammed-up, either to sustain a weak pattern, or to make the molders' "sand-joint."

Bottom Part.— The "drag" or bottom-half of a mold. In "bedding-in" work, the portion of the mold in the foundry floor.

Burning-off.— A process of tempering springs. The spring to be tempered is first hardened by immersion in linseed oil. When cold, it is taken out and the adhering film of oil ignited and allowed to burn off, thus producing a temperature of at least 600° Fahr., which draws the temper of the spring and coats it with a black surface that makes it practically rust proof.

Burning-on.— The replacing of a broken-off or incomplete portion of a casting. A mold of the portion which is to be burned-on is placed in the proper position against the main casting, and the molten metal poured in. The metal is allowed to flow over the broken face of the casting and out through a gate at the side of the mold, until the broken face is in a state of local fusion. The gate is then stopped, and the metal allowed to cool. Perfect amalgamation is attained by the method.

Case Hardening.—The treatment by which wrought-iron is hardened on the surface. It is first heated to a red heat in the presence of carbon, and absorbs enough of the carbon to transform it into steel on the outside. It is then chilled suddenly to harden the steel.

Chaplet.—The metallic devices used for supporting the "core" of a mold. Chaplets are of various forms—the single-headed chaplets, the double-headed chaplets, the spring chaplets, and the adjustable chaplets. They are placed under the cores to support them, or above the cores to hold them down, or at the sides of the cores to enable them to resist the lateral pressure exerted by the flowing metal.

Charging.— The supplying of furnaces with fuel and ores. In a reverberatory furnace, the "charging-door" or the opening through which the charge is introduced, is located at the side; while in a blast furnace or cupola, it is located near the top at the level of the charging platform.

Chart Method.— A method for computing the weight required for holding down the cope and core against the raising effort of the head of flowing metal. It consists in the drawing to scale the outline of the form and size of the lifting surface, and the height of the fluid head, and computing from the figure thus obtained, the cubical contents, which multiplied by the decimal .26 gives the data for the necessary weight.

Chills.— Metallic molds into which specially mixed molten iron is poured for the production of chilled or surface hardened castings. They are made of a quality of iron of sufficient strength and ductility to allow for the alternate expansion and contraction to which they are subjected, otherwise they would not last longer than one heat. Chills used for casting chilled-rolls are made in sections. "Contracting-chills" are used for casting chilled car wheels, and are so constructed, that as the metal of the wheel cools and contracts, the chills close in and keep in constant contact with it.

Cinder-bed or Coke Bed.— The first layer of coke placed in a cupola previous to the introduction of the iron. Its weight bears a definite relation to that of the iron, but varies with the condition of the furnace. The term "cinder-bed" is also applied to the beds of cinders sometimes placd under the molds and with which the vents are connected.

Clamping.— The weighting down of the cope of a closed mold preparatory to "pouring," to prevent its raising by the lifting force of the metal. It is accomplished by means of various forms of clamps and weights, the latter consist of piles of pig-iron piled in separate pigs on the cope, or cast-iron bars ranging from 1,000 to 2,000 pounds in weight, which are hoisted into position by a crane.

Cleaning or Cleaning-up.— The smoothing of the surfaces of a foundry mold with trowel and cleaners, and blackening, preparatory to "closing" and "casting." Also, the removal of sand from castings by means of wire brushes and files, by means of tumbling-barrels, and by various pickling processes.

Closing-up.— The placing on of the top-box or cope of a mold in readiness to pouring in the molten metal.

Cold Shuts.— When cast metal pours thick, or when it is poured into the mold too slowly, it is liable to thicken and partly solidify in those portions of the mold where the casting is thin, thus preventing the metal which follows from properly amalgamating with it. The imperfectly united contact surfaces thus formed are called "cold-shuts," "cold-shorts," or "cold-shots."

Cope.— The top-box or upper-half of a green-sand mold.

Core.— A body of green or dried sand placed in a mold to exclude the central or inner portion of a casting. They are made either in boxes called "core-boxes," or struck to shape upon a revolving bar, a mixture of loam being used for the body, and the required outline imparted to it by revolving it against the bevelled edge of a templet board called the "loam-board."

Drawing of Patterns.— The lifting of patterns from the sand. Also called "rapping," "delivery," etc.

Drawing Plates.— See Rapping.

Drawing of Temper.— The heating of steel to redness and then allowing it to cool slowly in the air. The reverse of "hardening" and "tempering."

Drop Forging.— The method of forging iron by driving or pressing it into a die placed under a drop hammer. It is employed when a number of forgings of the same pattern are required. A great deal of this class of work is now accomplished by the use of steam-hammers and forging-presses.

Fagoting.— The piling up of lengths of puddled bar-iron in fagots or bundles for the purpose of reheating and rolling.

Feeding.— When molten metal cools, the outside portions will set first, while the inside portions will remain fluid for some length of time. As the inner portion cools, it will contract and shrink upon itself and leave a depression on the top face of the casting. To avoid this condition the heavier portions of the casting are fed with metal through a small rod called the "feeding-rod," inserted through the runner or the riser, which by its motion keeps a passage open for the inflow of the fresh metal introduced to compensate for the contraction. The metal used for this purpose is called the "feeding-head."

Flask.— The box which holds the sand in which the pattern is rammed-up in the making of a mold. Flasks are made either of wood or of metal, and are parted horizontally into two or more sections. In a mold composed of two parts, the lowermost or the one which is molded first is called the "nowel" or "drag," and the uppermost or the one which is on top, when the casting is poured, is called the "cope." When a flask consists of more than two parts, the sections between the cope and the drag are called "cheeks" or "intermediates." Flasks are provided with two loose covers called top and bottom boards, and they are designated as "two-part flasks," "three-part flasks," "four-part flasks," etc., according to the number of the component parts.

Floor Rammer.— A flat-ended iron tool employed for ramming over large surfaces of sand.

Fluxes.— Substances used in a smelting, or in a melting furnace for combining with the earthy and other infusible matter present in ores, and which require to be separated from the metal; and which cannot be rendered fluid by itself at the temperature of the furnaces. The flux most widely used is a carbonate of lime in the form of limestone, clam and oyster shells, chalk, dolomite and calcite. Magnesia, fluorspar, feldspar, and calcspar are also suitable for this purpose. This by-product of the furnaces is called "slag."

Forge.— The structure upon which a smith's fire is maintained. Forges are constructed of brick, of brick and iron combined, or entirely of iron. A forge consists of a hearth, tuyere, chimney, bonnet, and troughs for water and coal. The blast is produced either by bellows, or by rotary blowers and fans.

Gaggers.— Short, conical projections cast upon the core-plates and the plates of loam-molds for the purpose of assisting the adhesion of the loam. The term is also applied to the hooks of cast-iron or of wrought-iron which are hung from the cross-bars of a molding box into the mold to prevent the sand from sliding out when the cope is lifted. They are necessary when the body of sand is more than sixteen inches square in area.

Gate.— The opening in the sand of a mold, which connects the "sprue" with the interior of the mold. The sprue is the orifice through which the molten metal is poured into the mold. Both terms are also applied to the bodies of metal which occupy the respective passages after the casting has been poured.

Hardening.— The hardening of a metal is the result of an increase in its density. Few metals are capable of being hardened. The hardening of steel is effected by heating it to a cherry-red temperature and then chilling or cooling it suddenly by plunging it in water, oil, or other suitable solution, or by exposing it to a cold blast. The degree of hardness that may be attained depends upon the suddenness of the chilling. In hardening and tempering tools such as machine knives, taps, long twist-drills, reamers, milling cutters, etc., the danger of warping them by uneven heating, or by cold draughts, is avoided by heating them in special hardening and tempering furnaces. See Case Hardening and Tempering.

Lifting.— The drawing out of a pattern from a mold. Also applied to the raising up or springing up of the cope or top-part of the mold caused by the pressure due to the head of the molten metal. This tendency is counteracted by the use of screw-bolts, clamps, and dead-weights. See Clamping.

Loam Work.— The making of molds in loam, as distinguished from that of molding in sand. The loam used in foundries consists of a mixture of clay, sand, and horsedung, ground up with water by means of a form of mortar mill called the "loam-mill." When cold, the loam has sufficient consistency to be struck up to any desired outline by means of a "loam-board." See Cores.

Lycopode.— A material used for "parting."

Match-plates.—A match-plate is a wooden board or plate of metal on the opposite faces of which two different portions of a pattern are attached. When the boxes containing the impressions are brought together, they constitute a complete mold. In some cases they are very useful for facilitating the making of joints, but they are generally used for making molds for castings having plain outlines, without sharp corners, cores, or projections.

Mold-boards.— Boards used for making molds for small castings having irregular joints. Their chief advantage consists in the saving of time and labor in forming the joints They are made of various kinds of material. The wooden mold-board is carved out in the desired shape of the joint. The plaster of Paris mold-board is used in cases where the pattern is very crooked, and where the other types cannot be made as cheaply, or to fit with the same amount of accuracy. The sand-and-composition mold-boards are the kind generally used, and obviate the necessity of ramming the sand. The composition consists of twenty parts of fine dry sand to one part of litharge, tempered with linseed oil. The match-plate is a form of mold-board.

Molding or Founding.— The making of molds for metal castings. The molds are made in sand, loam, and plaster of Paris, with or without the aid of patterns. There are three classes of molding — green-sand molding, in which damp sand is used, and the castings are made in damp molds, or in molds the surfaces of which have been "skin-dried;" dry-sand molding in which the damp sand molds are thoroughly dried in an oven preparatory to casting; and loam molding. See Loam Work.

Molding Sand.— Sand is used for molding, in preference to all other materials, on account of its refractory nature, which enables it to resist the destructive action of molten metal at high temperatures; on account of its porosity, which allows the free escape of the gases generated in casting; and on account of its peculiarly compact and adhesive properties, which not only permits of its being molded to any desired shape, but also enables it to resist a great amount of pressure exerted by a liquid. The best molding sand is obtained from the coal measures, and the later red sandstone formations. Sand from the green-sand and chalk formations is also very satisfactory. The most suitable sand is that which contains a large percentage of silica, with alumina and magnesia present in small quantities. The various grades of molding sand are designated as green-sand, dry-sand, core-sand, facing-sand, and parting-sand, according to the purposes for which they are used.

Odd Sides.— See Mold-boards.

Parting.— The act of separating the different parts of a mold-box. Also applied to the process of making the sand-joint between two contiguous mold-boxes. Also to the joint itself.

Pouring.— The filling in of a mold with molten metal in making a casting.

Print.— A projection placed upon a pattern to indicate the position of a cored hole, and to form an indentation for the reception of the end of the core. "Pocket-prints" and "parallel-prints" are used at the sides of the patterns.

Rapping.— The process of loosening a pattern from the sand previous to its withdrawal therefrom. This is effected by inserting the pointed end of the "rapping-bar" into the "rapping-hole" bored in the pattern or in a plate of malleable iron called the "rapping-plate," screwed on the face of the pattern. Small round-faced wooden mallets, called "rapping-mallets," are used in the actual process of withdrawal, which, unless carefully performed, will not only damage the pattern, but will enlarge the molds of small castings to a very appreciable extent.

Riddle.— A coarse sand sieve of about half-inch mesh, used for sifting coarse and old sand.

Riser or Air Gate.— A vertical opening which extends from the mold, through the cope, to the outer air. When it fills up with the molten metal it indicates that the mold itself is full.

Tempering.— In foundry work, it is applied to the process of mixing various grades of sand. In forge shop work, it signifies the imparting of a definite degree of hardness, or elasticity to steel. It is effected by either raising or letting down the metal to a certain temperature and then cooling it from that temperature by plunging it in water or oil. The degree of temperature is indicated by the various colors assumed by the steel during the heating part of the process. It may also be determined by the flashing point of a fat.

Venting.— The piercing or honeycombing of the sand of a mold by means of a long wire-rod, one-eighth or one-quarter inch in thickness, thrust in all directions, for the purpose of allowing the free escape of the gases generated by the decomposition of the moisture in the sand by the heat of the inflowing metal.

For further information relative to the various processes such as riveting, welding, boring, etc., which form an important part of foundry and forge shop work, see articles under the titles, **Boiler Shop Terms**, and **Workshop Terms**, in this Encyclopedia.

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Foundry Practice. *Casting.*— The casting of brass has been practiced from the earliest times and is mentioned in the oldest books of the Bible. Before the year 1300 wrought iron was made directly from the ore. It is nearly pure iron and cannot by ordinary methods be made sufficiently fluid to run into molds. By special methods in recent years it is made into steel castings (q.v.). At ordinary casting temperatures it is pasty and can be forged into various shapes. After 1300 cast iron was made which in addition to iron contains sufficient carbon and silicon to lower its melting point so that it can be made fluid. The presence of phosphorus, sulphur and manganese also influences the quality of cast iron. Until 1700 castings were generally made directly from the blast furnace in which cast iron was made from the ore.

The first casting known to have been made in America was a small round bottomed kettle with a cover. This was made at Lynn, Mass., in 1642 at the first blast furnace erected in this country. During the latter part of that century cast iron was remelted in crucible and in 1722 a French founder made the first primitive cupola in which the fuel and iron were placed in alternate layers. Foundry practice dates from that time. Before the beginning of the last century rarely more than a single casting was made from one pattern. Each new form required a different treatment.

The only foundry equipment until recent years was the cupola, a blower, a gib-crane, ladles, cleaning mills, sweeps for loam work and the molders individual tools: a shovel, bellows, rammer, and trowels, some of which are called slicks. By the duplication of castings from patterns in later years molders have become expert in special classes of work, especially when working by the piece. When large numbers of a single kind of castings are to be made a molding machine can be employed advantageously and these are rapidly coming into use. Machines can be operated with comparatively unskilled labor. Modern foundries are equipped with electricity and compressed air, travelling cranes and trolleys, which are used to transport materials, and to do the heavier part of the molder's work. While permanent metal molds are used for the softer metal castings, they have not been made successful for brass or iron.

Sand of various grades is used almost universally for molds and the founder's art consists in the making of sand molds. Molding sand is a mixture of silica sand and clay with from 10 to 15 per cent of impurities. It is strong if when dampened and pressed into shape it will not fall apart. Fine sand gives light castings a smooth skin. Heavy castings require a coarse open sand. The reddish color of molding sand comes from iron oxide. After the castings are removed from the sand it is shoveled into a row, then with the shovel, opened up and sprinkled evenly with water. The next morning beginning at one end the heap is cut over, giving each shovelful a twist to scatter the sand evenly over a new heap. About once a week enough new sand is added to make up for what is burned out.

Molding.— The different branches of molding have much in common. We will describe the simplest form and then show where the other forms differ.

Bench Molding.— The patterns for toys, hardware, small parts of stoves, light malleable iron, and many brass castings are made of metal, gated together so that the card of patterns is handled as a single piece. Melted iron is poured into a vertical sprue and runs to the mold through horizontal passages called gates. The card of patterns is bedded in a mold-board called a match which closely conforms to every parting or horizontal edge of the pattern.

The molder works standing, his match of patterns being placed on a frame or bench, with his heap of sand beneath and at the side. The mold is made in a snap flask, the lower part of which is the drag and the upper part the cope. These are guided together by flask-pins and both are hinged at the corner and hooked together at the opposite corners. The pattern is thoroughly brushed when the drag is inverted on the match. About half an inch of sand is riddled over the surface of the pattern. The drag is then heaped up with sand with a shovel. Then with a hand rammer, about 13 inches long, in each hand, the molder penes the edges of the drag twice around with the flat pene of the rammers, and levels off the surface with the side of the rammers. With the round butt ends the whole surface is rammed solid. The surplus sand is struck off with a straight edge, a little sand is sprinkled over the surface and a bottom board is rubbed to a fit. This with the drag and match are rolled over and the match is lifted off leaving the pattern bedded in the sand, when all loose sand is blown off with a bellows, and necessary repairs are made with a slick. The cope is put on, the sprue pattern is set on a pin in the gate pattern and a little parting sand is dusted over the surface. This burned parting sand cleaned from castings, prevents the cope from sticking to the drag.

The cope is rammed the same as the drag, the loose sand brushed off, the sprue removed and the hole smoothed with the fingers. The cope is lifted and placed on edge just behind the drag. The pattern is drawn and is held in the left hand while a bag of charcoal facing is shaken over the mold with the other. The pattern is printed back, rapped and drawn. The cope is then replaced on the drag, the flask is unhooked and the sand mold with its bottom board is set on the floor.

A molder in seven hours will make from 70 to 150 molds. They are stacked two or three high. Wooden frames or jackets are slipped over some molds to prevent the iron from bursting out at the sides. In pouring the molds, cast iron weights with slots in them to expose the sprue holes, are placed on the row of molds nearest the bench to prevent the iron from raising the cope. These weights are changed as fast as a row is poured.

Floor Molding. (Stove plate, etc.) — Each piece is molded in a wooden or in an iron flask. The cope is barred with cross bars six or seven inches apart, with the lower edges conforming to the shape of the inside of the pattern and about one inch away. If the bars are of iron they have holes cast in them and if of wood nails are driven in the lower edges to prevent the sand from dropping out. The pattern, usually of iron, is fitted to a wooden mold-board. The gates are generally separate from but set against the pattern. Whenever possible flat gates are used.

The molder's floor is perfectly level and generally of brick or cement. The sand heap extends the whole length and the flasks and mold-boards are piled at one side.

The pattern on its mold-board is placed on the front of the floor. The pattern is brushed, the drag is inverted on the board, sand is riddled on and then heaped up with a shovel.

The rammer for all floor work is about four feet long with a metal pene and butt. Sand is *pened* twice around the edge of the flask to prevent the iron running out and to make a hard parting. The sand is leveled with the hand and then stepping on the sand, by a series of backward jumps, the molder jumps it off, in rows lengthwise and crosswise. He then butts it all over, a little harder under the gates. He fits the bottom board, then removes it, cuts gutters across especially under where the gates will be and runs a vent wire one-eighth of an inch in diameter all over the drag nearly to the patterns. Then replacing the bottom board and clamping together the bottom board, drag and mold-board the mold is rolled over. After knocking the clamps off, the molder removes the mold-board, puts on the cope, and fastens it to the bottom board with clamps opposite each sprue. The sprue pattern is put in place, sand is riddled on, and then shoveled one quarter full. Then with a hand on each side of each bar, the sand is tucked with the fingers under the bar and around the sprues. The cope is heaped with sand and is pened around the sides of the cope and on each side of each bar. Then the sand is gathered by the hands between the bars and jumped off. The molder cleans the bars of sand and butts the sand all over, being careful not to hit the bars or the sand will not lift.

All loose sand is brushed off the surface of the mold and the sprue is removed. Metal wedges are pressed in between cope and drag at each corner, the clamps knocked off, and the wedges pushed clear in. The cope is rolled up nearly perpindicular and held there by an old file or piece of rod. The sprue is taken out and with a bellows all loose sand is blown from the drag and from the front and back of the cope. The sand is sponged at the edges of the pattern and the set gates.

After the pattern is drawn lead facing is dusted from a bag all over the mold to prevent the sand burning into the iron. Then charcoal facing is dusted on to prevent the lead sticking to the pattern. After printing the pattern back in the mold the set gates and pattern are drawn and the flask is closed and clamped. The iron should be poured as dull as possible to prevent the sand from burning into the iron. In the molding thus described the man molds the same piece over and over and becomes very expert, and generally working by the piece makes very good wages.

General Jobbing and Machinery Castings. (Roll Over Work.) — The previous description applies to this class also. Patterns are generally of wood and are made one-eighth inch per foot larger than the casting to make up for shrinkage. The pattern tapers at least one-eighth inch in a foot to help in drawing the pattern. Any overhanging parts of a pattern must be held by dowel-pins and such parts are drawn after the other part of the pattern is out.

It is better to have iron enter a mold from the bottom and for this purpose the sprue passes down to the bottom of the pattern and across to the mold through a hollow core molded into the drag. One or more risers are placed on the highest points of the mold through which the iron will rise after the mold is full. Dirt and gas will rise also and the riser may be large enough to allow churning with a rod to keep open a channel to the centre of the casting and through which melted iron may be poured to prevent spongy spots forming in the parts that cool last.

Flasks may be of three or more parts. Deep molds are rammed up in courses and harder in the lower portions to resist the head of metal. No soft spots, causing swells, or hard spots, causing scabs, must be made near the pattern. For heavy work about one inch of sand mixed with seal coal (ground bituminous coal) is riddled on all surfaces of the pattern to make a smooth casting.

When possible a pattern is made in two parts, divided at the parting line, allowing the drag part to be laid on a flat board. When an odd job is made without a mold-board a cope is inverted on a bottom board and rammed with sand and struck off. The pattern is roughly bedded in this sand.

Parting sand is thrown over the surface and the drag is rammed up. Then the mold is rolled over, the cope is taken off and the sand shaken out. The drag is then finished and the cope put on and the mold is finished.

Where there are deep places in the pattern the molder tucks sand around large nails with the heads down near the pattern, or sticks called soldiers, or gaggers, L pieces of rod or of cast iron the toe being near the pattern and the long end along the side of the bars. These must be tucked with the fingers and pened thoroughly. The molder then finishes the cope, venting thoroughly, especially around the sprues.

Molding by Bedding In.—In the foundry floor are pits filled with molding sand level with the floor. A hole is dug in this sand to take the pattern, around which the sand is packed. To allow for the escape of gas generated by a large quantity of iron, the hole is dug deeper than required for the pattern and a bed of very fine cinders is packed and connected by a pipe with the surface of the floor. The cinder bed is covered with sand. If the pattern is not deep or for open sand molds, the sand is leveled off even with the floor. Sand is packed in four small piles at the corners of the bed and two straight edges are leveled on these piles. Sand is tucked solid about these straight edges. Sand is then shoveled inside and outside and rammed hard outside the straight edges. The sand between is struck off.

After the molder has riddled sand three-quarters of an inch thick over the whole surface he places two strips about eight inches long and one-quarter to one-half inches thick on the ends of the straight edges. With a third straight edge on these strips he with his helper presses down first one end of the straight edge and then the other, moving across the bed, making all of an even hardness. He strikes off and vents all over the surface down to the cinder bed. Then with a fine sieve, a little facing sand is riddled over the whole surface and it is smoothed with a trowel. Strips of wood equal to the thickness of the casting are laid on the bed to represent the outside of the casting and the outside of the mold, and the gates are built up with sand. If pins or lugs are required on the lower surface, a pattern for them is pressed into the sand at the required points. A casting more than three inches thick is made with a cope.

Bedding In with a Cope.—If the upper surface of a casting is to be perfectly flat the cope with sprue holes may be rammed on any flat surface and can be set on the mold already bedded in the floor.

If a pattern with an uneven top surface has been bedded in the floor a cope is set in place and stakes are driven about it in the floor to insure its location, and the cope is then rammed. To raise the cope, flat boards are laid on the sand and with crowbars the corners are started, then it is lifted with the crane.

The cope is replaced and held down with iron weights so that the head of metal cannot raise it. Very large and complicated molds can be made in green sand. The mold may be formed by templets and by parts of patterns.

Sand may be built out from the sides by inserting anchors, or separate cores may be used. Such molds are faced by painting on lead facing with a camel's hair brush or by rubbing facing on with the hand.

Dry Sand Molds.—These are made from sand richer in loam than that used for green sand molds. They are made in iron flasks with iron bottom boards. The molding is substantially the same as green sand except that all joints are bevelled back from the mold so that when the cope is put on the edges will not crush. This causes a fin on the casting which is chipped off. The cope and drag are placed in an oven and thoroughly dried. Dry sand castings are more sound than if made in green sand.

Skin Dried Molds. (To obtain the advantages of dry sand molds, and of green sand bedded in work.)—Ordinary floor sand is used for the mold except the two inches of sand which faces the mold which is as rich in loam as for dry sand work. If the surface of an ordinary mold is to be only slightly dried, molasses water or thin clay water may be sprayed on the surface to make it strong when dry. A mold when finished is generally skin dried to a depth of one or more inches. Iron baskets filled with burning charcoal are hung in different parts of the mold or heated plates may be held near the surfaces or gas flames may be directed against the surfaces.

Loam Molding.—The body of the mold is built on iron plates with ordinary red brick laid in black mud, which is ordinary floor-sand mixed with clay wash. Some mix sawdust with the mud to make it porous and to help in drying the mold. Straw is sometimes laid in the joints for the same purpose. Pushing a vent wire between the joints also gives vent. This body is built about three-quarters of an inch away from the surface of the finished mold. On the brick surface is spread loam which is a mixture of sand, clay and water. This is faced off with trowels or sweeps. If the mold is circular such as a cylinder or a kettle, a spindle is located at the center of the mold. On this is fixed arms on which are fastened sweeps or templates. Made up cores are also used for giving shape to parts of the mold.

The outside or the inside of the mold with the bottom can be finished first as is most convenient. It is then taken to the oven by the crane. While this is drying the other part is built up and finished and dried. All parts are then put together, the bottom and top plates being bolted together with rods. A crib is built about the mold with steel or cast plates bolted together. Sand is rammed between the brick work and the casing, as hard as possible, forming also the gates for taking iron to the bottom of the mold. Water pipes and other specialty castings are made in iron molds fitted for the purpose and molding machines are used to a great extent for such work.

Every different pattern presents problems which require different treatment. Books on molding generally consist of descriptions of the making of molds for special castings and of difficulties encountered, but the ingenious methods familiar to all skilled molders are not described. One of the best descriptions of ordinary special processes is found in ‘Appleton's Dictionary of Mechanics’ under «Casting».

Cores are used in all classes of molds. An iron anchor may be coated with green sand and set in a mold. Dry sand cores are made of silica sand mixed with a binder such as floor, rosin or oil. When baked these binders make the core hard and strong, and the melted iron burns the binder so that the core sand falls out when the casting is cold. Cores are generally made in boxes. Wires or iron frames are molded in to give strength. Cores are vented by making channels with wires or by molding in a core and then drawing it out. For intricate cores cords of beeswax are molded in which melt out in baking. Cores are located by core prints in the mold left by the pattern and are held in place by chaplets of various shapes placed beneath to prevent sagging and above to prevent the iron from raising the cores. Nails forced into the mold are often used, the core resting on the heads. Tinning chaplets prevents rusting and helps the iron to fuse their surfaces.

Melting Iron.— Iron is melted in a cupola, a firebrick lined vertical cylinder in which is charged layers of coke and iron. A blower forces air through tuyers near the lower end. The melted iron is tapped out at the front into fire clay lined ladles and taken to the mold by hand ladles or by crane. For very large castings several cupolas are used and melted iron may be held in large ladles for some time while more is being melted. Air furnaces are also used for heavy castings.

Quality of Iron for Castings.— Silicon softens cast iron and decreases shrinkage, therefore a standard measure of shrinkage tells whether more or less silicon is needed. Strength depends very largely upon the size of grain, which is not wholly dependent upon the chemical composition. A thin portion of a casting shrinks more and sooner than a thick part which often causes fracture. It has been erroneously said that cast iron expands at the instant of solidification.

Iron becomes rigid at the surface of the mold while the central part is fluid. When all is solid, and just about as it ceases to be red hot, the casting expands more or less at the same time that carbon crystallizes into graphite. In a casting one inch square this expansion occurs about 15 minutes after the iron enters the mold but in a casting four inches square it occurs two hours after. This expansion at different times of parts of a casting of varying thickness, at the same time that the casting is shrinking unevenly from the loss of heat, produces severe strains which often fracture the casting. The remedy is to make all parts of equal thickness and to uncover thick portions as soon as solid.

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Author of ‘Cast Iron’. etc.

Fountain, or **Artificial Fountain,** in hydraulics, a machine or contrivance by which water is violently spouted or darted up; called also a *jet d' eau.* There are various kinds of artificial fountains, but all formed by a pressure of one sort or another on the water, namely, either the pressure or weight of a head of water, or the pressure arising from the spring and elasticity of the air, etc. When these are formed by the pressure of a head of water, or any other fluid of the same kind with the fountain or jet, then will this spout up nearly to the same height as that head, abating only a little for the resistance of the air, with that of the adjutage or pipe from which the water spouts, etc., in the fluid rushing through; but when the jet is produced by any other force than the pressure of a column of the same fluid with itself, it will rise to such a height as is nearly equal to the altitude of a column of the same fluid, whose pressure is equal to the given force that produces the fountain. In ancient Greece every principal town had public fountains or conduits, some of which were of handsome design and of beautiful execution. The most famous of these were at Megara, at Corinth (the Pirene and the Lerna), in the sacred wood of Æsculapius, at Epidaurus, and the two at Messina called Arisinoë and Clepsydra.

The ancient fondness for fountains still exists in Italy and the East. The French are celebrated for their fountains, but Italy, more particularly Rome, is still more so. The fountains of Paris and of the Tuileries, of the orangery at Versailles, at St. Cloud, and other places in the neighborhood, are splendid structures. The principal and most admired fountains at or near Rome are those in front of St. Peter's, of the Villa Aldobrandini at Frascati, of the Termini, of Mount Janiculum, of the gardens of the Belvedere, in the Vatican, of the Villa Borghese, which has also in the audience chamber a splendid fountain of silver, five Roman palms in height, ornamented with superb vases and flowers; the fountains of Trevi, the three fountains of St. Paul, of the Aqua Acetosa, etc.

In the United States the ornamental type of fountain is the one in common use. Large display fountains were attractive features of the Centennial Exhibition, and at the Chicago World's Fair and Buffalo Pan-American Exposition. Among these was the Fountain of the Republic of Chicago, which was designed by MacMonnies, and at Buffalo were costly examples dedicated to Man, Nature, Progress, etc. In Central Park, New York; Fairmount Park, Philadelphia; Lincoln Park, Chicago; Golden Gate Park, San Francisco, and other large parks, will be found numerous fountains of elaborate design. In all the larger cities drinking fountains for men and animals have been erected by individuals and local humane societies.

Fountain Pens. See Literary Labor-savers.

Fountains Abbey, one of the largest and best-preserved monastic edifices in England, in the West Riding of Yorkshire, 3 miles southwest of Ripon. Founded for Cistercians in 1132, it was not completed till the 16th century, and thus presents examples of every variety of style, from Norman to Perpendicular.

Fouqué, Friedrich Heinrich Karl, frēd'rĭh hĭn'rĭh kärl foo-kā', Baron de la Motte, German poet and novelist: b. Brandenburg 12 Feb. 1777; d. Berlin 23 Jan. 1843. He was a grandson of H. A. Fouqué (q.v.); served as lieutenant of the Prussian guards in the campaign of 1792, and was present in 1813 at the most important battles in the War of Liberation. As a writer he is remarkable both for variety and fecundity, and has published poetry in almost all its forms — dramatic, epic, romantic, etc. Several of his short romantic tales in prose, such as 'Der Zauberring,' 'Aslauga's Ritter,' but more especially his 'Undine,' enjoy an extraordinary popularity. The last mentioned tale, a charming mixture of fairy ideality, the reality of humble life, and the glow of chivalry, has gone through many editions, and has been translated into every European language. It must be admitted that Fouqué, while possessing many of the virtues of the romantic school, was guilty of all its extravagances, and that the descriptions of chivalric and feudal life, in which he delighted, are mere fancy pictures.

Fouqué, Heinrich August, hĭn'rĭh ow'-goost, Baron de la Motte, Prussian general; b. The Hague, Holland, 4 April 1698; d. Brandenburg 2 May 1774. Fouqué possessed the confidence of Frederick the Great; and the 'Mémoires du Baron de la Motte Fouqué' (1788, by Büttner, the secretary of Fouqué), which contain his correspondence with Frederick the Great, are of great interest.

Fouquet, foo-kā, **Nicolas,** French statesman, Viscount de Melun and de Vaux, and Marquis of Belle Isle; b. Paris 1615; d. Pignerol 23 March 1680. He received in 1650 the important appointment of procureur-général to the parliament of Paris, and three years later was advanced to be superintendent of finance. His rapid advance made him ambitious of succeeding Mazarin as first minister, but he had a formidable rival in Colbert. Fouquet's plans were, however, brought to naught; for in the first place Louis himself took the reins of power into his own hands when they slipped from the grasp of the dead cardinal, and in the second place, instigated thereto by Colbert, he suddenly arrested Fouquet in September 1661. After a trial extending over three years, Fouquet was sentenced to perpetual exile and the loss of all his property, but the sentence was afterward altered to life-long imprisonment. From the circumstance of his imprisonment at Pignerol, Fouquet, in spite of the fact that he died in 1680, has been identified with the Man With the Iron Mask (q.v.), who, however, lived till 1703.

Fouquier, foo-kē-ā, **Henry,** French publicist: b. Marseilles 1 Sept. 1838. After study of law and medicine he became a journalist in Paris, general-secretary of the prefecture of Marseilles (1870), and director of the press in the ministry of the interior. He wrote much for the *Figaro* and *XIX. Siècle*, but particularly for *Gil Blas*, under the pen-names "Colombine" and "Nestor," and was a founder of the *Echo de Paris*. In 1889 he was elected deputy for Alpes-Maritimes. His articles have been collected in several volumes under such titles as 'Etudes Artistiques' (1859); 'Au siècle dernier' (1884); 'La sagesse parisienne' (1859).

Fouquier-Tinville, Antoine Quentin, äṅ-twäṅ kĕn-täṅ foo-kē-ā täṅ-vēl, French revolutionist: b. Hérouelles, near St. Quentin, 1747; d. Paris 7 May 1795. As a member of the revolutionary tribunal he distinguished himself by his alacrity in pronouncing the verdict of guilty, and attracted the attention of Robespierre, who gave him the office of public accuser before this tribunal. The victims now became numberless. Fouquier drew up the scandalous articles of accusation against the queen, Marie Antoinette. His thirst for blood seems to have been increased by gratification, until it became a real insanity. He proposed the execution of Robespierre and all the members of the revolutionary tribunal 9th Thermidor, 1794, was himself removed on the 14th Thermidor (1 Aug.), 1794, and arrested. He died under the guillotine. There does not appear to be a trait in the life of this monster which can entitle his crimes to the same palliation as those of Robespierre, who considered the extermination of the aristocracy as a necessary evil. Consult Domenget, 'Fouquier-Tinville, et le tribunal révolutionnaire' (1878).

Four-eyed Fish, a fish of the genus *Anableps.*

Four-horned Antelope, or **Chousingha,** the genus *Tetraceros* of the antelope group, native to India, and differing from all other living ruminants in that the male generally bears two pairs of horns. It is closely related to the African duikerbok (q.v.), which it resembles in the position of its larger horns, and the shape of its eyes, as well as in other ways. The smaller horns rise from just above the eyes. This antelope is a pretty, brownish creature, standing about 25 inches at the withers, and is found from the foot of the Himalayas southward over India, in wooded hill-country, but it avoids dense jungles. It drinks daily, and hence never wanders far from the water. It is exceedingly shy, and escapes, when discovered, in a series of jerky, though very rapid, bounds, into the cover of long grass or low bushes.

Four Lakes, a chain of lakes in Dane County, Wis.; known respectively as First, Second, Third, and Fourth lakes. First Lake, the smallest and lowest of the chain, is about 3 miles long by 2 miles wide; Second Lake is 3½ miles long by 2 broad; Third Lake is 6½ miles long by 2 miles wide; Fourth Lake, the largest and most beautiful, is 6 miles long by 4 wide. The waters of these lakes are navigable for small steamers. The two last are now called lakes Monona and Mendota.

Four-o'clock. See Friar-bird.

Fourcroy, Antoine François de, äṅ-twän fräṅ-swä dė foor-krwä, French chemist: b. Paris 15 June 1755; d. 16 Dec. 1809. Having adopted the profession of medicine he applied himself closely to the study of the sciences connected with it, especially to chemistry, and published in 1776 a translation of Ramazzini's ‘Treatise on the Diseases of Artisans.’ He was professor of chemistry at the Jardin du Roi, 1780-1805. He organized the central school of public works, out of which the polytechnic school afterward sprang, and co-operated in the establishment of the normal schools. In 1799 Bonaparte gave him a place in the council of state, in which place he drew up a plan for a system of public instruction, which, with some alteration, was adopted. His works are numerous, among which the following are the most important: ‘Leçons Elémentaires d'Histoire naturelle et de Chimie’ (1791); ‘Système des Connaissances chimiques, et de leurs Applications aux Phénomènes de la Nature et de l'Art’ (1805); ‘Philosophie chimique’; ‘Tableaux synoptiques de Chimie’ (1805); and ‘La Médecine éclairée par les Sciences physiques.’

Fourdrinier (foor-drĭ-nēr') **Machine,** a paper-making machine, the first to make a continuous web. It was invented by Louis Robert, of Essonne, and patented by him in France. A Mr. Gamble and the brothers Fourdrinier improved it. The machine was perfected by others.

Fourier, François Charles Marie, fräṅ-swä shärl mä-rē foo-rē-ā, French social economist: b Besançon 7 April 1772; d. Paris 10 Oct. 1837. He studied at the college in his native town, and obtained a mercantile position at Rouen; he later entered into business on his own account at Lyons, having inherited a small fortune from his father, but the siege of the city by the troops of the convention in 1793 and the subsequent disorders were fatal to his prosperity; he was arrested and kept a prisoner for some time, and afterward served two years in the Revolutionary army. When he was 19, while employed at Marseilles, his employers retained a cargo of rice in order to keep up the price, and when it became unfit for use ordered Fourier to throw it into the sea. This experience led him to question the righteousness of the existing industrial system and to develop his own social theory known as Fourierism (q.v.). He first published ‘Theorie des quatre Mouvements et des Destinées generales’ (1808), in which he explained the basis of his system, which he developed more completely in ‘Traite de l'Association domestique agricole’ (1822), republished under the title ‘Theorie de l'Unité universelle,’ and in ‘Le Nouveau Monde’ (1829-30). See Pellarin, ‘Charles Fourier, sa vie et sa théorie’ (5th ed. 1871; American translation, 1845).

Fourier, Jean Baptiste Joseph, zhŏṅ bäp-tēst zhō-zĕf, Baron, French mathematician: b. Auxerre, France, 21 March 1768; d. 16 May 1830. He was an active Jacobin during the French Revolution. His later energies were divorced from politics and given up to science. ‘Analytical Theory of Heat’ (1822) is his most noted work; but in mathematics his speculations and methods are of high permanent utility.

Fourierism, foo'rĭ-ĕr-ĭzm, **the social system** advocated by F. M. C. Fourier (q.v.). It was based on the theory that the social order depends upon fixed moral and intellectual laws, and that man must discover and live according to these laws. According to Fourier society must be so organized as to give freedom to the passions or desires of man, since these are naturally capable of harmony, and, if developed under proper conditions, would, in accordance with the law of attraction, lead to a perfect society. In this society industry should be carried on by phalanxes, each phalanx to be divided into series, and the series combined in groups; each group was to have charge of one kind of work, and each series of one special branch of that work. In the distribution of products a certain minimum was to be assigned to each member of the society, whether capable of labor or not; the remainder to be shared in certain proportions to be previously determined among the three elements, labor, talent, and capital. The capital of the community might be owned in unequal shares by different members of the community; inheritance was to be permitted, and the individuals could expend the remuneration they received as they pleased. The government was to be republican, with elective officers. Fourierism, though socialistic, is not properly socialism, and is related to modern socialism by its sharp criticism of existing conditions, rather than by its plan for the future of society.

Fourierism won many converts in France; among those who advocated the theory were Victor Considerant and Mennier; an association was formed; a periodical, the ‘Phalange,’ was published for a short time; and a number of communities were organized in accordance with the Fourieristic plan, none of which long survived. Fourierism was introduced into the United States in 1842, by Albert Brisbane, who for a time published ‘The Phalanx,’ in New York. He was welcomed by the members of the Brook Farm community, and the Fourieristic organization was adopted there. For a time the ‘Brook Farm Phalanx’ published ‘The Harbinger,’ the most important periodical published by the Fourierists in the United States. An organization, known as the American Union of Associationists, was formed for the «popular diffusion of the principles of the associative sciences as discovered by Charles Fourier, with a view to their ultimate realization by the establishment of phalanxes.» Horace Greeley (q.v.) became its president, and George Ripley (q.v.) secretary. A large convention of the «associationists» was held in New York in 1844. In 1847 ‘The Harbinger’ was transferred to New York under the charge of this association, and was published till 1849. About 34 communities were organized by the Fourierists, of which the most important (besides Brook Farm) were the North American Phalanx, which lived 12 years, and the Wisconsin Phalanx. Most of them existed but a short time, and by 1850 the Fourierist movement had practically come to an end. Consult: Brisbane, ‘Social Destiny of Man’; Ely, ‘French and German Socialism’; Noyes, ‘History of American Socialisms’; Shaw, ‘A Forgotten Socialism’ (‘New England Magazine,’ new series Vol. VIII., p. 773). See Brook Farm; Communism; North American Phalanx; Socialism.

Fourier Series, in mathematics, a trigonometric series first extensively employed by the French mathematician Jean Baptiste Joseph

Fourier, in connection with the theory of the movement of heat in a solid body. It was primarily intended for effecting the development of an arbitrary periodic function in the form of a series whose terms are sines and cosines of increasing multiples of the variable. The subject is too technical for discussion in a general encyclopædia. Consult: Fourier, 'The Analytical Theory of Heat' (translated by Alexander Freeman); and more especially, Byerly, 'An Elementary Treatise on Fourier's Series, and Spherical, Cylindrical, and Ellipsoidal Harmonics.'

Fourth Nerve, one of the pair of cranial nerves, and the chief motor nerve of the superior oblique muscle of the eye. It originates in a group of cells in the floor of the medulla and runs outward over the superior elevator muscle of the eyelid, and is distributed to the orbital surface of the superior oblique.

Fourth State of Matter. See ELECTRON; MATTER; RADIUM.

Foussa. See FOSSA.

Fouthill Abbey. See BECKFORD, WILLIAM.

Fouke (originally **Smith**), **Gerard,** American archæologist: b. Maysville, Ky., 25 June 1855. In 1885–8 and 1891–3 he was connected with the United States Bureau of Ethnology in surveys and explorations of aboriginal remains in the eastern part of the country. Further research by him includes explorations for the American Museum of Natural History, New York, on the lower portion of the Amur River, Siberia, and on Vancouver's Island, British Columbia; and excavations of so-called Norse remains in the vicinity of Boston, Mass. His published writings comprise essays on archæological subjects in the bulletins and reports of the Bureau of Ethnology and elsewhere.

Fowl, a word originally synonymous with bird, now used in a stricter sense to designate the genus *Gallus,* of which the common domestic fowl (cock and hen) is a familiar example. The general form and characters of the bill, feet, etc., agree with those of the pheasants, but the crown of the head is generally naked and furnished with a fleshy comb, the base of the lower mandibles also bearing fleshy lobes or wattles — characters which are most conspicuous in the males. The jungle fowl of India (*Gallus ferrugineus,* or *bankiva*) is regarded as the source of domestic poultry; it is known also in southern China and throughout the Malay islands. The male closely resembles the game-cock. The comb and wattles are of the brightest scarlet, the long hackles of the neck and lower parts of the back are fine orange-red, the upper part of the back is deep blue-black, and the shoulders ruddy chestnut. The long, arched, and drooping tail is blue-black, glossed with green, and the breast and under parts black. The word is also commonly applied in such combinations as wildfowl, waterfowl, seafowl, and the like. For the characteristic of domestic fowls, see POULTRY.

Fowler, Charles Henry, American Methodist clergyman: b. Burford, Ontario, Canada, 11 Aug. 1837. He was graduated at Genesee College in 1859 and at the Garrett Biblical Institute in 1861; studied law; was pastor for 11 years in Chicago, Ill.; president of the Northwestern University in 1872–6; and corresponding secretary of the Missionary Society in 1880. He was elected a bishop of the Methodist Episcopal Church in 1884; visited Japan, Korea, and China in 1888; organized the Peking and Nanking universities; was stationed for eight years on the Pacific coast; founded the Maclay College of Theology in Southern California, and assisted in founding Wesleyan University in Lincoln, Neb. He was sent as a fraternal delegate to the Wesleyan Conference in Great Britain i. 1898. He died N. Y. City, 20 March 1908.

Fowler, Ellen Thorneycroft, English novelist. She is the daughter of Sir Henry Fowler, secretary of state for India 1894–5. Her published works include: 'Verses Grave and Gay' (1891); 'Verses Wise and Otherwise' (1895); 'Concerning Isabel Carnaby' (1898); 'A Double Thread' (1899); 'The Farringdons' (1900); 'Love's Argument' (1900); 'Sirius, and Other Stories' (1901); 'Fuel of Fire' (1902).

Fowler, Frank, American artist: b. Brooklyn, N. Y., 12 July 1852; d. 18 Aug. 1910. He studied at Florence, at Paris with Carolus Duran and in the Beaux-Arts, established a studio at New York in 1880, and became known as a portrait painter. His subjects include S. J. Tilden, Archbishop Corrigan, C. A. Dana, and other notabilities. He was elected a National Academician, and has published manuals of art: 'Oil Painting'; 'Drawing in Charcoal and Crayon'; 'Portrait and Figure Painting.'

Fowler, SIR John, English civil engineer: b. near Sheffield 1817; d. London 20 Nov. 1898. In 1844 he was appointed to superintend the construction of the Manchester, Sheffield, and Lincolnshire system, a connected group of railways, and other works of vast extent and complexity. He subsequently was employed on many civil engineering works both in England and elsewhere; but the work with which his name will probably be most lastingly connected is the great bridge across the Forth, of which he was chief engineer, having as his colleague Sir Benjamin Baker. (See BRIDGE.) On its completion in 1890 he was made a baronet.

Fowler, Joseph S., American lawyer: b. Steubenville, Ohio, 31 Aug. 1820; d. 1902. He became professor of mathematics at Franklin College, Tenn., and was president of the Howard Female College in Gallatin, Tenn., in 1856–61. Subsequently he was State comptroller under Andrew Johnson, and was a United States senator 1866–71. In 1871 he retired from political life and engaged in law practice in Washington, D. C.

Fowler, Lorenzo Niles, American phrenologist: b. 1811; d. 1896. He was a brother of Orson Squire Fowler (q.v.). From 1863 he resided in England. He was a publisher of the 'Science of Health' (originally the 'Water-Cure Journal') and the 'American Phrenological Journal,' and wrote 'Phrenology and Physiology' (1844).

Fowler, Montagu, English Anglican clergyman: b. London 12 Nov. 1858. He was educated at Harrow and Cambridge; took orders in the Established Church, was vicar of St. Lawrence, Isle of Thanet, Kent, 1889–93, and has been rector of All Hallows, London Wall, from 1900. He has published: 'Christian Egypt'; 'Some Notable Archbishops of Canterbury'; 'Church History in Queen Victoria's Reign.'

Fowler, Orson Squire, American phrenologist: b. Cohocton, Steuben County, N. Y., 11 Oct. 1809; d. Sharon, Conn., 18 Aug. 1887. He was graduated at Amherst College in 1834, and opened a phrenological office in New York in 1835. In 1836 he and his brother Lorenzo wrote and published 'Phrenology Proved, Illustrated and Applied,' and in 1838 issued the first number of the 'American Phrenological Journal.' Subsequently he lectured on his specialty and allied subjects in the United States and Canada, and wrote and published numerous books, including 'Self-Culture and Perfection of Character'; 'The Self Instructor in Phrenology'; 'Human Science'; etc.

Fowler, Thomas, English philosopher: b. Burton-Stather, Lincolnshire, 1 Sept. 1832. He was educated at Merton College, Oxford, and from 1873 to 1889 was professor of logic in the university. Since 1881 he has been president of Corpus Christi College. His published works include: 'Elements of Deductive Logic' (1867; 10th ed. 1892); 'Elements of Inductive Logic' (1870; 6th ed. 1892); an edition of Bacon's 'Novum Organum,' with introduction and notes (1878; 2d ed. 1889); a little work on 'Locke' (1880); an edition of Locke's 'Essay on the Conduct of the Understanding' (1881; 3d ed. 1890); 'Francis Bacon' (1881); 'Shaftesbury' (1882); 'Hutcheson' (1882); 'Progressive Morality: an Essay in Ethics' (1884; 2d ed. 1895); 'History of Corpus Christi College, Oxford' (1893); 'Principles of Morals' (Part I., introduction written with J. M. Wilson, 1885; Part II., the body of the work, by Prof. Fowler alone, 1887; both in one volume, revised 1894); and 'Popular History of Corpus Christi College' (1898).

Fowler, William Warde, English ornithologist: b. Somerset 1847. He was educated at Marlborough College and Oxford, and has been sub-rector of Lincoln College, Oxford, from 1884. He has published: 'A Year With the Birds' (1886); 'Tales of the Birds' (1888); 'Life of Julius Cæsar' (1892); 'The City-State of the Greeks and Romans' (1893); 'Summer Studies of Birds and Books' (1895); 'The Roman Festivals of the Republican Period' (1899); 'More Tales of the Birds' (1902).

Fowler, William Worthington, American author: b. Middlebury, Vt., 24 June 1833; d. Durham, Conn., 18 Sept. 1881. He was the author of 'Ten Years in Wall Street' (1870); 'Fighting Fire' (1873); 'Woman on the American Frontier' (1877); 'Twenty Years of Inside Life in Wall Street' (1880).

Fowler's Solution. See ARSENIC.

Fox, Charles James, English statesman: b. London 24 Jan. 1749; d. Chiswick, Surrey, 13 Sept. 1806. He was the son of Henry, 1st Lord Holland, and was educated at Eton and Hertford College, Oxford. His father procured him a seat for the borough of Midhurst in 1768 before he was of legal age, and in 1770 the same interest procured him the office of one of the lords of the admiralty, which post he resigned in 1772, and was appointed a commissioner of the treasury.

After being a supporter of the administration for six years, Fox was ejected owing to a quarrel with Lord North, and was thrown into the ranks of the Opposition. The adoption of the disastrous measures which terminated in the independence of the American colonies enabled him to take this part without opposing any of the policy which he had previously supported. During the whole of this eventful contest he spoke and voted in direct opposition to the ministerial system, and, in conjunction with Burke, Barré, Dunning, and other eminent parliamentary leaders, displayed the highest talents both as a statesman and orator. On the final defeat of the administration of Lord North and the accession of that of the Marquis of Rockingham, Fox obtained the office of secretary of state for foreign affairs. But the death of the Marquis of Rockingham suddenly divided the party, and on the Earl of Shelburne becoming first lord of the treasury Fox retired and soon after a union took place between his friends and those of Lord North, under the name of the coalition. The temporary success of this party movement served only to render popular disgust the more general; and the dismissal of the coalition excited general satisfaction. Though in the new Parliament Pitt had a decided majority, Fox headed a very strong opposition, and political questions were for some years contested with a display of talent on both sides which the House of Commons had seldom previously exhibited.

In 1790 and 1791 Fox regained a share of popularity by his opposition to war with Spain and Russia, and also by his libel bill, regulating the rights of juries in criminal cases and rendering them judges both of the law and the fact. On the breaking out of the French Revolution he was disposed to regard it as likely to prove extremely beneficial. The contrary views of Burke, and the extraordinary manner in which that ardent politician on that account publicly renounced his friendship, is one of the most striking incidents in parliamentary history.

The opinions formed of this eminent leader as a practical and theoretical statesman have been as various as the shades of party difference. That he was a sincere friend to all the broad and generous principles on the due development of which rest the freedom and best interests of mankind, is not to be doubted, and that they were alloyed by great latitude on the subject of party and political expediency is equally clear. As a powerful and purely argumentative orator he was of the very first class; though as to eloquence and brilliancy he perhaps yielded to Pitt, Burke, and Sheridan; nor were his voice and manner prepossessing, though highly forcible. Of his amiability in private life, after making allowance for a dissipated youth, all accounts agree. Friends and foes equally testify to his ingenuous and benign character. As an author, besides some Latin poetry and a Greek dialogue, by which he highly distinguished himself at Eton, and a few numbers of a paper, entitled 'The Englishman,' he published nothing during his lifetime but 'A Letter to the Electors of Westminster' (1793). To his nephew, Lord Holland, the world is indebted for his posthumous publication, entitled 'The History of the Early Part of the Reign of James II.' It is written with unpretending simplicity, but disappointed expectation, and has never been popular. See Lord John Russell, 'Life and Times of C. J. Fox' (1859-66); Wakeman, 'Life of Charles James Fox' (1890); Trevelyan, 'Early History of Charles James Fox' (1881).

Fox, George, English religionist, founder of the Society of Friends: b. Drayton, Leicestershire, England, July 1624; d. London 13 Jan. 1690. While yet a boy he was distinguished by his gravity and exemplary conduct. When in the 20th year of his age, and for some two or three years afterward, Fox describes himself as having been in a distressed state of mind, but from this condition he was at length delivered by that which he regarded as the voice of God in his soul, directing him to Christ as alone able "to speak to his condition." Very soon after this he commenced his public ministrations at Dukinfield, Manchester, and the neighborhood. From the first his preaching seems to have made many converts and excited much opposition. Fox's first imprisonment took place in the year 1648, in consequence of his opposing the preacher in "the great steeple-house at Nottingham," on a point of doctrine. In 1650 he was imprisoned at Derby under a false charge of blasphemy. One of the committing justices, Bennet, acted with great violence on this occasion, and it was he who on Fox's bidding him "tremble at the word of the Lord" first applied to him and his friends the name of Quakers. Fox lay in prison at Derby for about a year, the time having been lengthened in consequence of his refusal to accept a commission as captain of one of the regiments then being raised by Parliament. To his belief of the unlawfulness of all war, which prompted this refusal, was added at the same time a clear view of the enormity of the punishment of death for crimes affecting property only, and he exerted himself to save the life of a poor woman then in jail for theft. Within 10 years of Fox's appearance as a preacher, meetings of the Friends were established in most parts of England. At the same time, so actively were they persecuted, that for many years there were seldom less than 1,000 of them in prison. Cromwell, though himself favorable to liberty of conscience, seems to have been unable to curb the excesses of popular hostility launched in all quarters against a sect which denounced all state interference with religion and maintained that the gospel should be preached without fee or reward. About a month after the restoration of Charles II., Fox was committed to Lancaster Castle, "on the charge of being a common disturber of the peace, and of endeavoring to make insurrection and embroil the whole kingdom in blood." After lying in jail some months, a habeas corpus was obtained, and the authorities showed their disbelief of these grave charges by allowing Fox himself, unbailed and unguarded, to convey to London the sheriff's return to the writ. The hopes entertained by the members of the young society that they would be allowed a breathing-time from persecution were dispelled at the commencement of 1661 by the atrocious measures which followed the mad attempt of Venner and his Fifth-Monarchy men. The act empowering magistrates to tender the oaths of allegiance and supremacy to any person whom they thought fit to suspect, also operated with great severity against the Friends; under its provisions Fox was committed to prison at Lancaster in the beginning of 1664, whence he was removed to Scarborough Castle, where he lay till the autumn of 1666. In 1669 Fox married Margaret Fell, the widow of one of the judges of the Welsh courts. The year 1670 witnessed the passing of the most stringent of the Conventicle Acts, forbidding under heavy penalties the assembling for religious worship, in any house, of more than four persons besides the family, except according to the usages of the Church of England. Soon after his recovery from a severe illness he sailed for Barbadoes, where he exerted himself greatly in the interests of religion and humanity. It was while in this island that Fox drew up a statement of his own and his friends' belief in all the great doctrines of Christianity — a statement clearly disproving their alleged sympathy with Socinian tenets. After a considerable time spent in Barbadoes, Jamaica, and the North American continent, he returned to England in 1673, where further persecutions awaited him. He underwent 14 months' imprisonment in Worcester jail, and was at length liberated by the Court of King's Bench on account of the errors in his indictment. In 1677, in company with Penn and Barclay, who had joined the Society about 10 years before, he paid a visit to Holland and some parts of Germany, where his services seem to have been well received. The last 15 years of his life were tranquil as regards personal molestation, but he continued to be actively engaged in various ways in promoting the welfare of his brethren. Their persecutions continued throughout the reign of Charles II. In the first year of William and Mary was passed the bill which nullified the Conventicle Acts, and allowed the Friends to make a solemn declaration in lieu of taking the oaths, and Fox had the gratification of seeing the public worship of the Society legally recognized before his death. (See FRIENDS, SOCIETY OF.) His works were issued in three volumes 1694–1700. Consult: Sewell, 'History of the Quakers'; Lives by Marsh (1848); Janney (1853); Watson (1860); Tallack, 'George Fox, the Friends and the Early Baptists' (1868); Bickley, 'George Fox and the Early Quakers' (1884).

Fox, George L., American actor: b. Boston, Mass., 3 July 1825; d. 24 Oct. 1877. He first appeared at the Tremont Street Theatre in the 'Hunter of the Alps'; became known as a low comedian at the National Theatre, New York; was a lieutenant in the Union army at Bull Run, and later became manager of the New Bowery Theatre. Here he gained for himself a distinct position by his burlesque imitations of favorite tragedians of the time, and his pantomimes, the best of which was 'Humpty Dumpty,' in which from 1867 to his retirement in 1876 he appeared as the clown.

Fox, Gustavus Vasa, American naval officer: b. Saugus, Mass., 13 June 1821; d. New York 29 Oct. 1883. He was appointed to the United States navy in 1838, in which he served till 1856, when he resigned with the rank of lieutenant. He was subsequently appointed assistant secretary of the navy, and held this post till the end of the Civil War. He planned a number of operations for the navy, including the capture of New Orleans; and was sent by the government on the monitor Maintonomoh to convey the congratulations of Congress to Alexander II., on his escape from assassination. His visit to Russia materially aided the acquisition of Alaska by the United States, and was the longest voyage then made in a monitor.

Fox, John William, American novelist: b. Bourbon County, Ky., 1863. He was graduated from Harvard 1883 and has published: 'Hell for Sartain and Other Stories' (1897); 'A Mountain Europa' (1899); 'The Kentuckians' (1898); 'Crittenden' (1900); 'Blue Grass and Rhododendron' (1901); 'The Little Shepherd of Kingdom Come' (1903).

Fox, Margaret, American spiritualist: b. Bath, Canada, 1836; d. Brooklyn, N. Y., 8 March 1893. She was about 12 years old when her family were startled by mysterious rappings. All endeavors to trace them to any physical source proved unavailing. Various experiments were tried, but the «occult» power refused to act save in the presence of Margaret and her sister Leah. The family moved to Rochester, N. Y., but the raps followed and heavy bodies were moved without appreciable agency. In 1849 the sisters appeared in a public hall; when the same phenomena were freely manifested and tested. In 1850 the two girls went to New York, the «manifestations» became the subject of public discussion, and «mediums» sprang up all over the country. In 1888 Margaret made a public exposure of her pretended «manifestations,» which she subsequently contradicted.

Fox, William Carlton, American diplomatist: b. St. Louis, Mo., 20 May 1855. He first came into prominence as United States consul at Brunswick, Germany (1876–88). Subsequently he was United States vice-consul-general at Teheran, Persia. He organized the American Missionary Hospital during the cholera epidemic there in 1892, and established and edited the only strictly diplomatic and consular journal ever attempted in the United States.

Fox, William Freeman, American forester: b. Ballston Spa, N. Y., 11 Jan. 1840. He was graduated at Union College in 1860; studied engineering; served in the Civil War; and subsequently took charge of the Department of Forestry of New York State. He is the author of: 'Regimental Losses in the Civil War'; 'The Adirondack Spruce'; 'State Forestry Reports' for 1885–1901; and magazine articles on forestry, etc.

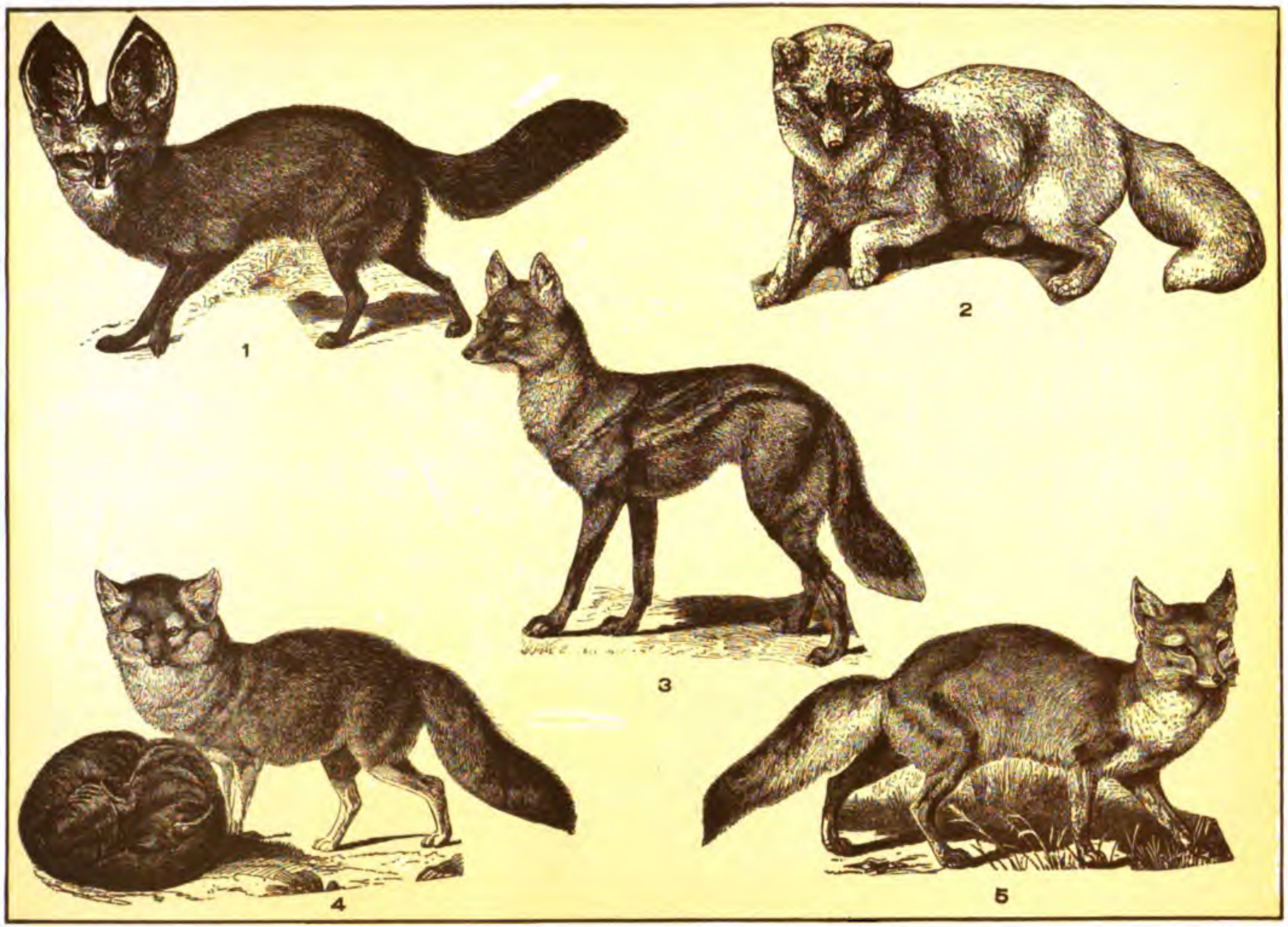
Fox, William Johnson, English orator and political writer: b. near Wrenthaum, England, 1786; d. London 3 June 1864. A weaver's son, he early showed signs of ability and was picked out to be educated for the Independent ministry. Once ordained, his rationalistic opinions cut him off from all the denominations. He became a radical active in politics, and spoke and wrote with persistent vehemence against the Common Laws. He was elected to Parliament in 1847, but was twice defeated at subsequent elections. His vigorous pen and eloquent voice aided the cause of popular social and political progress in England at a critical time in her history.

Fox, one of a group of small, long-eared, bushy-tailed animals of the dog-tribe (*Canidæ*), mostly included in the genus *Vulpes;* specifically, in literary usage, the red fox (*V. vulgaris*), called *renard* by the French and *reinicke fuchs* by the Germans. Foxes differ from wolves and jackals in being smaller, having shorter legs, longer, more furry and pointed ears, a more slender elongated muzzle, and a longer and more bushy tail; and they incline to that yellowish red color called «foxy.» But these distinctions are difficult of limitation (see FENNEC; FOX-DOG), and some naturalists refuse to recognize a separate genus for them. One fixed character is found in the pupil of the eye, which when contracted becomes elliptical in the foxes but remains round in other dogs. All the typical foxes are inhabitants of northerly latitudes, and well represented by the common red fox, which may be regarded as distributed throughout the whole northern hemisphere, though variously named in different countries, where local diversities exhibit themselves; thus the American variety is called *V. pennsylvanicus,* but it is not essentially different from those of the Old World. Its variations are as great here as in Europe and Asia, especially among those of the Far North, where certain color-phases have superior value in the fur-trade. Thus a fox marked with a dark line along the spine and another over the shoulders, is called a «cross» fox, and fine specimens are worth an extra price. Wholly black ones are uncommon; but the rarest and most valuable pelt is that of a «silver» fox, that is, a black one in which so many hairs are white-tipped that a hoary or silvered appearance is given to the skin. The red fox is fostered for the sport of fox-hunting (q.v.) in Great Britain, and in some parts of Eastern America, but in most countries he is regarded merely as a fur-bearer, or a poultry thief or worse, and is trapped, shot and poisoned continuously. Nevertheless, the animal survives and multiplies in the midst of civilization, by virtue of its power of comprehension of and adaptation to new conditions; so that he has acquired, very justly, a reputation for alertness, wit and cunning in contrivance for food and safety. In America this species is constantly extending its range southward at the expense of the gray fox. Another species yielding a valuable fur is the Arctic or blue fox (*V. lagopus*), which is found on all Arctic coasts, and although brownish in summer, becomes in winter pure white; but the under fur is always bluish, and in those of Alaska this color prevails over brown in summer. Certain of the Aleutian Islands have lately been devoted by local fur companies to the rearing of these foxes in semi-captivity, where they are cared for, and a selected number annually sacrificed to trade. North America has two other well-marked species. One is the swift or kit fox (*V. velox*) of the plains, which is only 20 inches long, exceedingly swift of foot, expert in digging and cunning at concealment. It has reddish-yellow fur in summer, but becomes dull gray in winter, with black patches each side of the nose. The other species is the gray fox, which was once generally distributed over the United States but has become extinct in the northeastern part since the general clearing and settlement of the country. It is a woodland animal, still numerous in the South and West. Its hair is stiffer and duller in color than that of the red fox, and it is so peculiar in structural respects (among others in having a concealed mane of stiff hairs on the top of the tail) that it has been classified in a separate genus as *Urocyon argenteus.* Several well-known species dwell in Asia, the best-known of which is the familiar fox of northern India (*V. bengalensis*).

Foxes everywhere are burrowing animals or else adapt to family needs holes in rocks, hollows of old stumps, and similar conveniences. They hide by day and go abroad at night in search of small prey, stalking and catching birds on their nests, or at roost on the ground, ground-

RED FOX

FOXES



1. Cape Fox or Lalande's Dog. 2. Arctic Fox. 3. Side-striped Jackal or Quaha.
4. Silver Fox. 5. Corsac.

squirrels, mice, frogs, and insects, and also eating largely of certain roots, fruits and other vegetable food. They are hardy, hunt all winter and climb mountain peaks. They never hunt in packs, as do wolves; and their voice is nearer a bark than a howl. They do not readily submit to domestication, and seem to have contributed little if anything to the composition of domestic breeds of dogs.

Consult for information on Old World foxes, the writings of Bell, Brehm, Blanford, Mivart and Beddard, well-summed up in Lydekker's 'Royal Natural History,' Vol. I. For American foxes, read Richardson, Hearne, Audubon, Merriam, the writings of Nelson, Turner and Murdoch on the natural history of Alaska, and the general remarks in Cram and Stone's 'American Animals' (1902).

Fox Bats. See FLYING-FOX.

Fox Channel, in the Hudson Bay, Canada, named after Luke Fox, who explored the region in 1631. The channel lies between Southampton Island and Baffin Land.

Fox-dog, a name given by certain naturalists to the wild dogs of South America, because of their fox-like appearance. Among these are the crab-eating dog (*C. cancrivorous*); the zono, or Azara's dog (*C. asaræ*), of which the «colpeo» of the pampas and southward is probably a local variety; the small-eared Brazilian dog (*C. microtis*, of Mivart), and two other aberrant Brazilian dogs (*C. urostictus*, and *C. parvidens*) for which a separate genus (*Nothocyon*) has been proposed by Wortman. All these animals have a striking external resemblance in color and form to the foxes, and connect them with the typical dogs. They are not well known, however. Consult: Mivart in the 'Proceedings' of the Zoological Society of London (1890); Beddard, 'Mammalia' (1902), and writers upon the zoology of South America. See BUSH-DOG.

Fox-hound, a breed of hounds, concerning whose origin practically nothing is known, save that they were probably first bred in Great Britain. This, perhaps the handsomest and most perfect of all hounds, is essentially a field dog, presenting an eminently powerful, well-built appearance, with his clean-cut, compact body, and giving evidence of muscular strength and endurance in the hunt. The head is full, with a broad brow, a long, wide muzzle, and open nostrils. The ears are set low and lie close to the cheek. The eyes are soft and brown. The chest is broad, and the ribs are deep, so as to afford plenty of breathing space. The muscular body is set on legs as straight as a post, and very strong; and the feet are round and cat-like. The color varies from black to tan and white, and the coat is hard, smooth and glossy. The American breed is lighter and finer in lines than the English fox-hound, has longer, thinner, and more pendant ears; a slightly narrower chest, and a rougher coat. He is used in fox-hunting as is the English fox-hound; but is also employed in hunting the moose, and other large game, especially in the Canadian forests. See DOG.

Fox-hunting, the chase of the fox with horses and hounds, as a recreation. This sport arose in England with the Restoration, when changes in customs and agricultural conditions caused the disappearance of falconry, and has become surrounded by codes of social usage and of legal enactments. It flourishes most in the south-central counties of England, and in Ireland, and some of the principal organizations or «hunts» as the Belvoir, Quorn, Pytchley and Cottesmore, were founded early in the 17th century. A «hunt» is an association for the promotion and regular practice of the sport in a certain district. It acquires a pack or several packs of fox-hounds (q.v.), kennels and perhaps a club-house, is directed by a «master of fox-hounds,» and served by paid employees, the principal of whom are the «huntsman» who arranges and leads the sport for the day, and the «whippers-in,» who see that the dogs work properly. These officials, and the sportsmen themselves wear «pink» (that is scarlet) coats when in the field. The expenses are paid theoretically by annual subscriptions, eked out by casual subscriptions for temporary privileges, but usually they must be supplemented by a patron,— probably the «M. F. H.,» who has inherited the dignity and its responsibilities from ancestors who founded the hunt. Anyone may join in the chase, and at Melton Mowbray and other famous «meets» large numbers of outsiders are often present. In these districts foxes are carefully preserved, and the abode and habits of each family of them are studied with reference to the autumnal and winter sport. At the appointed time the hunters, men and women, mounted and accompanied by a pack of from 25 to 40 hounds, are led by the huntsman toward the place where he expects to «find» a fox. There the dogs are loosed, and range about searching for the scent-traces in the air or on the ground left by the recent passage of the animal. When one finds a trail he gives tongue, the others come to his aid and the pack dash away following the scent. With a bugle-signal or cry of «Gone away!» the hunt follows as straight and fast as possible, keeping to roads, lanes, and gates where possible, but jumping fences and riding over grain-fields and meadows where needful, the hunt paying such damages as follow. This requires a horse of great speed and leaping power, and has developed the English thoroughbred hunter. When anyone catches sight of the fox he shouts «View! halloa!»; and the ambition of all riders is to keep close to the racing animals and be on the spot, or «in at the death,» when the fox is seized. It is then the duty of the huntsman, or the nearest rider, to save the body of the fox from the dogs, cut off its «brush» (tail), «pads» (feet), and «mask» (head) to be given as trophies to the foremost riders. The remainder of the fox is cut up and given to the dogs on the spot. Instead of running «straight away» and leading a long chase the fox will often take refuge in a drain or other hole, unless it has been «stopped.» This is called «going to earth,» and he must then be ousted by the aid of a fox-terrier.

Fox-hunting has been carried wherever Englishmen have settled, but has found few parts of the world favorable to it. In some countries, as on the North American prairies, in California, and in the Argentine Republic, similar methods are adapted to the chase of other animals, as wolves or kangaroos. In the southern and eastern United States, however, where foxes abound, true fox-hunting has flourished ever since colonial days, when each man brought his own hound or hounds to the assembly; and is still pursued by several established clubs in Virginia, Maryland, and southern Pennsylvania, where the nature of the country and the agricultural habits of the people favor it. These clubs employ a modified form of hound better adapted to the faster and rougher work required of it than would be the English breed. A special strain, the Magnes hound, has been fostered by the Maryland clubs, the foremost of which is the Elkridge. More nearly conforming to the English models is the establishment and hunting of the Meadowbrook Hunt, on Long Island, N. Y., where, in a level open country, largely occupied by extensive estates and within easy reach of New York, the sport has flourished since about 1876, and is likely to be long maintained.

An extensive and pleasing literature has grown up about this subject, and many thousands of titles would be required for its bibliography. A good general view may be obtained by reading the volumes devoted to the sport in the English ‘Badminton Library’ and in the American ‘Sportsman's Library.’

Fox Indians (French name Renards, «foxes,» from their fox-totem; their own name Musquaki, «red-earthers»; Ojibwa name Outagami, «other-siders»), an Algonkian tribe originally on Lake Superior; driven by the Ojibwa and French south of the Wisconsin River, where their losses forced them about 1760 to unite with the Sacs or Sauks. Hence from early in our acquaintance with them the joint tribe has been known as «Sacs and Foxes,» and they have practically coalesced. They joined the British in the Revolution, and again in the War of 1812; their lands gradually taken away, they moved westward into Iowa, were involved in the Black Hawk war and gave up more land, finally gathered on the Des Moines, and in 1842 were removed to the Osage.

Fox Islands. See Aleutian Islands.

Fox River, a river of Wisconsin, called by the Indians Neenah. It rises in Marquette County, near the centre of the State, and after a course of about 200 miles passes through Lake Winnebago; it enters the head of Green Bay. A canal has been cut from Fox River to the Wisconsin, which is a navigable affluent of the Mississippi, and the channel of the river below Lake Winnebago has been cleared to admit steamboats from Lake Michigan and Green Bay. A grant of land was made by Congress to assist the work.

Fox Shark, or Sea-fox. See Thresher.

Fox-snake, a large harmless snake (*Caluber vulpinus*) of the northern Mississippi valley, light brown in color, marked on the back with small chocolate spots bordered by black, and with a series of smaller spots along the sides and on the yellowish abdomen. It reaches a length of three feet, is irritable and pugnacious, and feeds upon small mammals, especially gophers, mice, and other pests of agriculture.

Fox-sparrow, a large American sparrow (*Passerella iliaca*), notable for its foxy red plumage, and gay song. It is a spring-and-fall migrant in the United States, breeding only north of the Saint Lawrence. See Sparrow.

Fox-squirrel, the largest of the true squirrels (*Sciuriss niger*). These rusty-coated squirrels are denizens of woods. They live in hollow trees or high among the branches, in nests of dry grass, and feed upon fruits, berries, mushrooms, and seeds of various trees. They have been hunted until they have become somewhat scarce in the woods north of Virginia; but southward, they are far more numerous. The flesh is esteemed as food — especially in Florida. Though safe from the depredations of preying birds, because of their size and strength, fox-squirrels are attacked by the foxes and wildcats, which kill and eat them.

Fox-terrier, a small terrier dog modified from the old-fashioned English white terrier of uncertain origin. It has a dense smooth coat white, with black or black-and-tan markings; and a small black nose; and it generally weighs between 15 and 20 pounds, when in good condition. The fox-terrier has a narrow, tapering face, and small, deep-set eyes, usually gentle, but capable of an expression of keen animation; the jaws are strong and well-shaped; and the V-shaped ears droop forward close to the cheek. The compact little body is set on straight, supple legs, and the tail, usually docked, is carried in a rather jaunty fashion. The dog's appearance is one of alertness; and, though originally bred to run the fox to earth, fox-terriers have, latterly, become popular not only as vermin-destroyers about stables, but as house-dogs,— their cleanly, sprightly, and affectionate ways rendering them extremely amiable and entertaining as companions. One variety, the «wire-haired,» has a rather long coat, of rather shaggy appearance. In all other points this is like the smooth-coated variety. See Dog.

Foxe, John, English martyrologist: b. Boston, Lincolnshire, 1516; d. London April 1587. In 1543 he was elected a fellow of Magdalen College, Oxford. Applying himself to theology with great assiduity, he secretly became a convert to the principles of the Reformation. This tendency being suspected, a charge of heresy followed, and by the judgment of his college he was, in 1545, expelled. In the reign of Mary he went abroad, and gained a livelihood by correcting the press for an eminent printer at Basel, where he laid the first plan of his ‘Acts and Monuments of the Church.’ On the accession of Elizabeth he returned to his native country, and was received in the most friendly manner by his former pupil, the Duke of Norfolk, who maintained him as long as he lived, and settled a pension on him at his death. Cecil also obtained for him a prebend in the Church of Salisbury. His principal work is the ‘History of the Acts and Monuments of the Church’ commonly called ‘Foxe's Book of Martyrs,’ first printed in 1563, in 1 volume folio; reprinted in 1632 and 1641 in 3 volumes folio. In 1684 it had reached the ninth edition.

Foxglove. See Digitalis.

Foy, fwä, **Maximilien Sebastien,** French military officer: b. Ham, France, 3 Feb. 1775; d. Paris 28 Nov. 1825. He entered the army at 15, and made his first campaign under Dumouriez in 1792. He received his 15th wound on the field of Waterloo, but refused to quit his post till the close of that engagement. He was afterward employed as inspector-general of infantry; and in 1819 was elected a member of the Chamber of Deputies, where he distinguished himself as an orator, and was a great public favorite.

Fra Angelico, än-gĕl'ē-kō, the common appellation of Fra Giovanni da Fiesole, one of the most celebrated of the early Italian painters: b. Vecchio, 1387; d. Rome, 18 March 1455. He entered the Dominican order in 1407, and was employed by Cosmo de Medici in painting the monastery of St. Mark and the Church of St. Annunziata with frescoes. These gained him so much celebrity that Nicholas V. invited him to Rome to ornament his private chapel in the Vatican, and offered him the archbishopric of Florence, which was declined. His works were considered unrivaled in finish and in sweetness and harmony of color, and were made the models for religious painters of his own and succeeding generations. See Cartwright, 'The Painters of Florence' (1901).

Fra Diavolo, frä dē-ä'vō-lō, real name **Michele Pezza,** Neapolitan brigand: b. Itri, Calabria, 1760: d. 1806. He became a monk, but was expelled on account of misconduct. He then became leader of a troop of brigands. The government set a price upon his head; but when Cardinal Ruffo undertook to compel the French to evacuate Naples, Fra Diavolo was pardoned, was employed by the cardinal, and received a colonel's commission. At the head of his band he harassed the French, took refuge in Calabria after the conquest of Naples by Bonaparte, and incited the people against the French. He fell into their hands at San Severino in 1806, and was executed.

Fracastorio, Girolamo, jē-rō'lä-mō frä-käs-tō'rē-ō, Italian poet and physician: b. Verona 1483; d. Tacassi 6 Aug. 1553. He was patronized by Cardinal Bembo, to whom he addressed the most celebrated of his works, a Latin poem entitled 'Syphilis.' In the latter part of his life he wrote a poem on the adventures of the patriarch Joseph, but his poetic fire seems then to have been exhausted, and the virtues of the hero were less happily celebrated than the horrors of the disease. Among the moderns who have exercised their talents in the composition of Latin verse, few have obtained higher reputation than Fracastorio.

Frackleton, Susan Stuart Goodrich, American artist: b. Milwaukee, Wis., 5 June 1848. She received a private education, and became prominent as a ceramic artist. She has won many prizes in American, European, Canadian, and Mexican competition; invented a gas-kiln for firing decorated china and glass; and was the founder and first president of the National League of Mineral Painters. In 1901 she received a medal at the Paris Exposition for her exhibit of pottery. She published 'Tried by Fire,' a work on china decoration (1885).

Fraction, a part of any integer (whole number), or unit. For example, "two and a fraction" means two units and that part of a unit which can be distinguished, as one half, two fifths, and so on. In the fraction ⅓ in arithmetic, or $\frac{a}{b}$ in algebra, the figure 1, or a, is the numerator, and 3, or b, is the denominator; and they represent that, if a whole number is divided into three or b parts, only one or a parts are taken. In the addition of fractions, the fractions must be brought down to the same denominator, and their numerators (as expressed in the value of their new denominator) must then be added, when we have one whole fraction. Thus, if we want to add ⅓ and ⅖, we must find the least common multiple of 3 and 5, which is found to be 15; then, as 3 goes 5 times into 15, and 5 goes 3 times into the same number, we multiply the numerators of the different fractions by these respective quotients, and then add the two quantities together. Thus, ⅓ added to ⅖ will be equal to $\frac{5}{15}+\frac{6}{15}=\frac{11}{15}$. The true definition of a fraction may be thus summed up: It is the division of its numerator by its denominator; as seven eights are equivalent to the whole number 7 divided by 8 — whence a fraction is obtained. Decimal fractions simplify calculations greatly, as they are constructed on the principle of having one common denominator — a multiple of 10; and thus fractions can be added, subtracted, and divided without repeating over and over the tedious process of bringing them down to a common denominator. See ARITHMETIC; DECIMALS.

Fracture, a break or solution of continuity in a bone, caused by sudden application of violence from without or by sudden muscular strains. Bone diseases and the changes in bone incident to old age predispose to breaks. Compound fractures are those in which a wound allows a communication between the injured bone and the body surface. A fracture is said to be multiple when there is more than one line of cleavage; when the lines of cleavage are joined, the fracture is spoken of as comminuted. Pain in the affected part and more or less loss of function are usually present. Examination reveals a deformity either as a swelling or a deviation from the normal line of the part; palpation elicits exquisite tenderness on direct pressure at the point of injury and on moving the fragments; the bony irregularity may be felt beneath the skin; frequently an abnormal point of mobility may be discovered; crepitus is present as a peculiar grating sensation transmitted to the examining fingers if the ends of the bone can be rubbed together.

Repair of the injury takes place through certain blood-cells organizing the clot of blood and forming a fibrous callus. Later this callus is absorbed and a bony callus formed, the lime-salts being laid down in orderly arrangement by special cells. Nature is assisted in this process by fixation of the fragments in their normal position. This reduction of the deformity requires surgical skill, and all unnecessary manipulation of a bone supposed to be fractured should be avoided. Where removal of the injured from the scene of the accident is necessary, further damage may be prevented by the careful restriction of motion of the part. This can be done by the application of splints or by otherwise securing the part.

Compound fractures are serious because of the great possibility of infection gaining access to the injured bone, with resulting inflammation and necrosis. Measures of fixation are modified to allow of careful aseptic wound-dressing.

The diagnosis of fracture is frequently a matter of great difficulty, so closely may it resemble in its signs a bruise or dislocation. The X-rays render great service in differentiation and study of the kind of break.

Pott's fracture is the name given to a fracture of the lower extremity of the leg-bones, usually accompanied by a turning out of the foot. The ankle-joint is commonly injured and the ligaments ruptured so that more or less permanent disability is usual. Colles' fracture is a break of the lower end of the radius, having generally a characteristic deformity. The upper fragment is jammed down toward the rest and overrides the lower fragment, which is pushed forward. Falls upon the open hand are often apt to cause this injury. Fractures of the patella or kneepan are difficult to treat, owing to the constant pull of the strong muscles on the upper fragment. Entire apposition of the fragments and bony union is rarely possible unless wiring is resorted to. This injury is frequently a result of sudden muscular strain. The upper end of the femur or thigh-bone is frequently fractured in the aged. When the patient is old or feeble the long-continued rest in the recumbent position which is necessary to proper union so lowers the vitality that deformity is frequently accepted through fear of a fatal termination.

Fractures of the skull-bones present some unique features because of the peculiar structure of the bones in two tables, the globe-like arrangement of the skull as a whole, and of the juxtaposition of the easily injured brain. Lines of fracture may travel far from the actual point of injury, and a breaking force may travel to an opposite pole of the skull. The ordinary signs of fracture are absent except the deformity which usually is found as a crack or depression. The element of depression of the fragments is of the greatest importance, usually necessitating the operation of trephining for the relief of cerebral pressure. This operation consists in the removal of the fragments or of the indented area. Hemorrhage from a fracture may cause pressure and necessitate similar relief. Fatal termination is common, particularly where the inaccessible base of the skull is involved.

Fra'denburgh, J. N., American Methodist clergyman: b. Gouverneur, N. Y., 4 March 1843. He was graduated from Genesee College, was professor of mathematics in the Genesee Wesleyan Seminary (1868–9), of ancient languages in the Fredonia Normal School (1869–73), and principal of the Mansfield (Pa.) Normal School (1873–5). After pastorates at Cleveland, Ohio, and elsewhere, he was settled in 1896 at Clarion, Pa. He has published: 'Witnesses from the Dust' (1885); 'Beauty Crowned' (1887); 'Living Religions' (1888); 'Departed Gods' (1891); 'Fire from Strange Altars' (1891); 'Light from Egypt' (1897); 'Life's Springtime' (1900).

Framingham, Mass., a town in Middlesex County, on the Sudbury River, and on the New York, N. H. & H., and the Boston & A. R.R.'s; about 20 miles west of Boston. It comprises the villages of Framingham, South Framingham, and Saxonville. It has a large industry in woolen goods, and an assessed property valuation of nearly $9,000,000. Pop. (1910) 12,948.

Franc, a French silver coin, containing 10 décimes and 100 centimes. Value in American money 20 cents.

Français, François Louis, fräñ-swä loo-ē fräñ-sä, French painter: b. Plombières, department of Vosges, 17 Nov. 1814; d. 1897. He was a pupil of Corot and Gigoux at the Beaux Arts, first exhibited at the Salon in 1837, obtained a medal of the first class at the Salon of 1848, and was admitted a member of the Institute in 1890. He became best known as a landscapist, particularly for his views of the Paris environs and glimpses of the Seine. His finest work, 'Daphnis and Chloë,' is in the Luxembourg, together with three other canvases, 'Evening,' 'Orpheus,' and 'The End of Winter.' His style is peculiarly individual in its combination of realism and idealism.

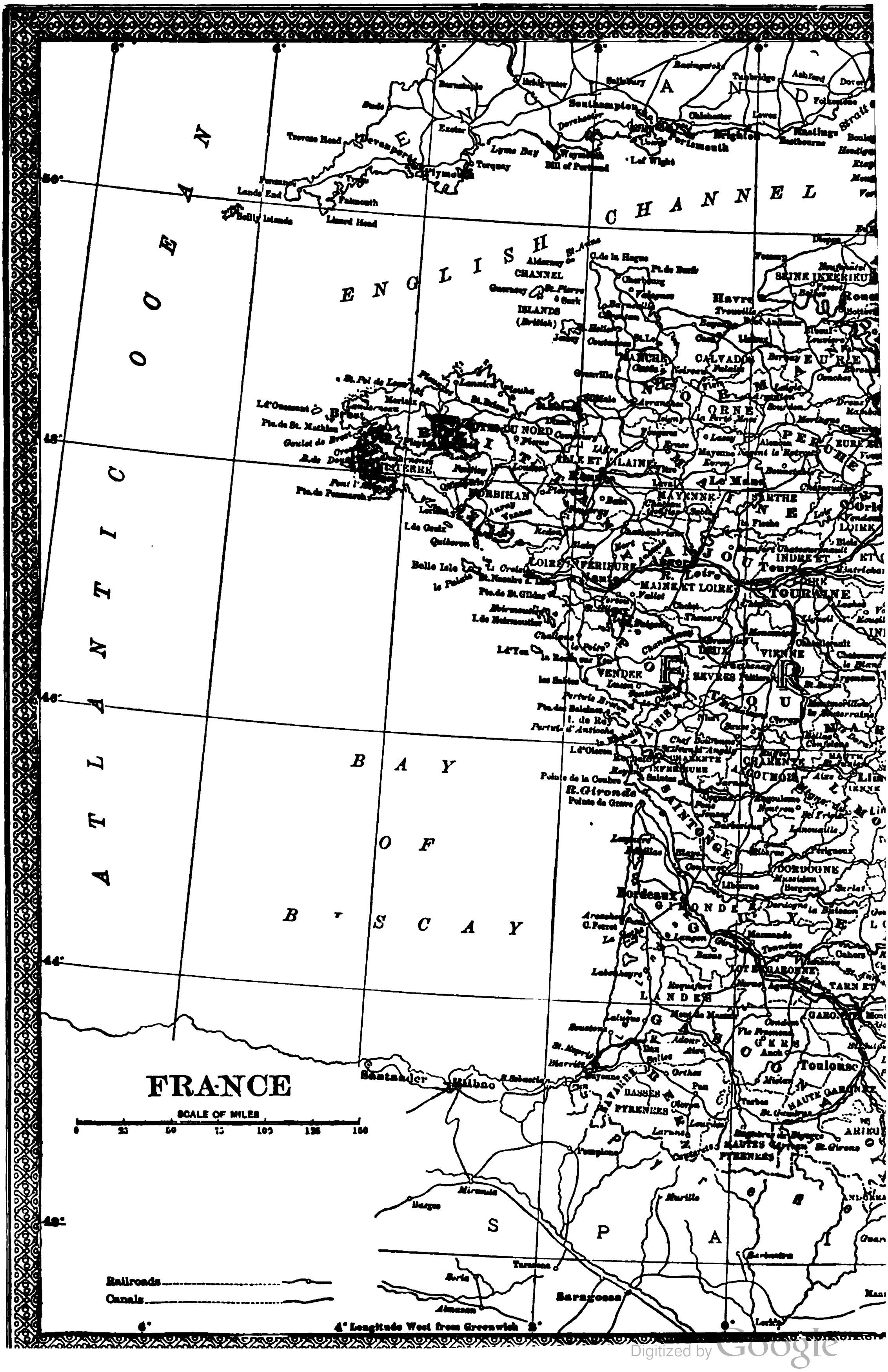
France, fräñs, **Anatole.** See THIBAULT, JACQUES ANATOLE.

France, Joseph, French publicist: b. Lorraine 1787; d. 1869. Having entered the French army in 1815, he had become a colonel in 1834, and in 1836–46 was commander of military police in the island of Martinique, West Indies. The publication of his 'La vérité et des faits' (1841), a work descriptive of the ill-treatment of negro slaves in the island, caused his removal from his post and trial for sedition. He was deprived of his commission, but subsequent to the abolition of slavery in the French colonies (1848) was elected from Martinique to the Constituent Assembly, and from 1852 was a member of the council of the island. His publications include: 'Les corsaires français dans les Antilles' (1857); 'Questions coloniales' (1860); 'Statistique de la Martinique' (1861).

France, frăñs, **Lewis Browne,** American author: b. Washington, D. C., 8 Aug. 1833; d. Denver, Col., 8 June 1907. He was educated at Georgetown College, and entered the practice of law in Colorado, of whose supreme court reports he edited volumes III.-XI. He wrote: 'Rod and Line' (1884); 'Mountain Trails and Parks in Colorado' (1886); 'Over the Old Trail' (1894); 'Pine Valley' (1897).

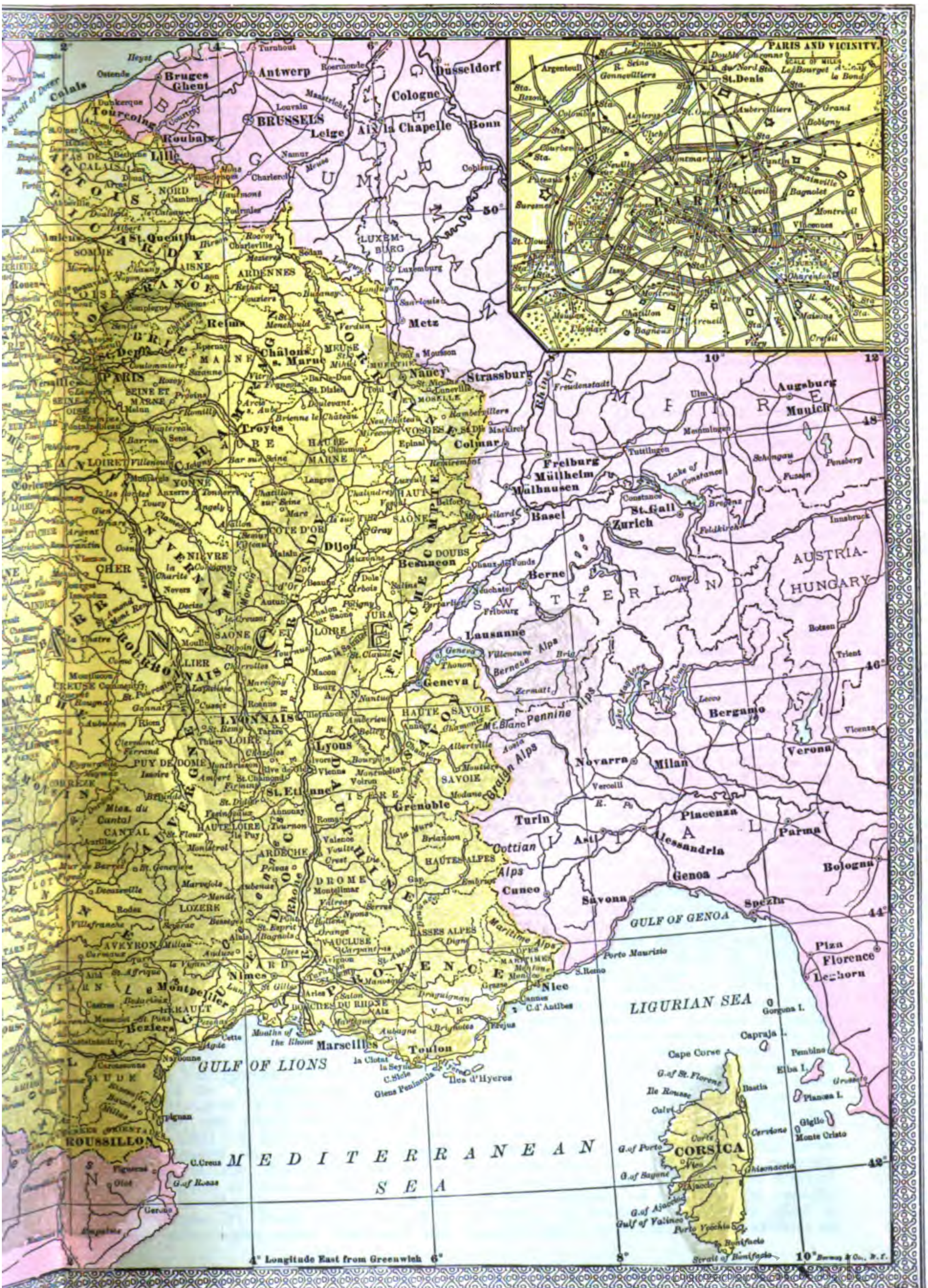
France, in ancient times called Gallia, a maritime country in the west of Europe, since 1870 the largest and most prominent republic in Europe, and the second largest in the world. France is situated between lat. 42° 20' and 51° 5' N.; and lon. 4° 50' W. and 7° 40' E., and is bounded north by the long stretch of the Straits of Dover; northwest by the English Channel; west by the Atlantic, more especially that part of it called the Bay of Biscay; south by Spain and the Mediterranean Sea; east by Italy, Switzerland, and the German territory of Alsace; northeast by German Lorraine, Luxembourg, and Belgium. The longest lines which can be drawn across France are two diagonals, which intersect each other — the one from the southeast to the northwest extremities, 670 miles, and the other, from the southwest to the northeast extremities, 555 miles. Measured on the meridian of Dunkirk, the greatest length is 600 miles, and measured on the parallel of 48° 20', the greatest breadth is 547 miles. The breadth near the centre is 400 miles, and along the parallel of 46° 15', where it is narrowest, does not exceed 340 miles. The total area of France is 207,054 square miles.

Topography.— While protected by great natural barriers at most parts where it is connected with the continent, a long line of coast on the west and northwest gives it immediate access to the great ocean thoroughfare, while on the



FRANCE

SCALE OF MILES
0
25
50
75
100
125
150
Railroads
Canals
4° Longitude West from Greenwich
50°
48°
46°
44°
42°
ATLANTIC OCEAN
ENGLISH CHANNEL
BAY OF BISCAY
ENGLAND
SPAIN
CHANNEL ISLANDS (British)
Alderney
Guernsey
Jersey
Sark
Barnstaple
Exeter
Southampton
Salisbury
Brighton
Portsmouth
Dover
Folkestone
Hastings
Eastbourne
Chichester
Lewes
Ashford
Tunbridge
Basingstoke
Dorchester
Weymouth
Bill of Portland
Lyme Bay
Torquay
Plymouth
Devonport
Falmouth
Penzance
Lands End
Scilly Islands
Lizard Head
Trevose Head
Bude
I. of Wight
Boulogne
Dieppe
Havre
Rouen
SEINE INFERIEURE
CALVADOS
MANCHE
ORNE
EURE
NORMANDIE
Cherbourg
Valognes
Caen
St. Lo
Coutances
Granville
Avranches
Alençon
Lisieux
Honfleur
Bayeux
Trouville
Falaise
Argentan
Le Mans
MAYENNE
SARTHE
Laval
ILLE ET VILAINE
Rennes
COTES DU NORD
Brest
FINISTERE
MORBIHAN
BRETAGNE
St. Brieuc
St. Malo
Morlaix
Lannion
Quimper
Lorient
Vannes
Belle Isle
Quiberon
I. de Groix
L'd'Ouessant
Pte. de St. Mathieu
Pte. de Penmarch
LOIRE INFERIEURE
Nantes
St. Nazaire
Pte. de St. Gildas
Noirmoutier
I. de Noirmoutier
L'd'Yeu
MAINE ET LOIRE
Angers
Saumur
ANJOU
Tours
TOURAINE
INDRE ET LOIRE
VIENNE
Chatellerault
Poitiers
POITOU
DEUX SEVRES
Niort
VENDEE
les Sables
Pertuis Breton
I. de Ré
Pertuis d'Antioche
L'd'Oleron
la Rochelle
Rochefort
CHARENTE INFERIEURE
CHARENTE
Angoulême
Saintes
SAINTONGE
Cognac
Pointe de la Coubre
R. Gironde
Pointe de Grave
Bordeaux
GIRONDE
Libourne
DORDOGNE
Perigueux
Bergerac
Sarlat
C. Ferret
Arcachon
La Teste
Langon
Marmande
LANDES
Mont de Marsan
Dax
Bayonne
Biarritz
St. Sebastian
BASSES PYRENEES
Pau
Orthez
Oloron
Lourdes
Tarbes
HAUTES PYRENEES
Auch
GERS
Agen
TARN ET GARONNE
Montauban
Toulouse
HAUTE GARONNE
St. Gaudens
St. Girons
ARIEGE
ANDORRA
Santander
Bilbao
Pamplona
Saragossa
Tarazona
Soria
Burgos
Miranda
Huesca
Barbastro
Lerida
GASCOGNE
NAVARRE
LIMOUSIN


PARIS AND VICINITY
PARIS
St.Denis
Argenteuil
Le Bourget
Montmartre
Belleville
Bagnolet
Montreuil
Vincennes
Charenton
Issy
Montrouge
Chatillon
Arcueil
Vitry
Ivry
Gentilly
Bagneux
Sevres
St. Cloud
Suresnes
Puteaux
Courbevoie
Colombes
Asnieres
Clichy
Neuilly
Aubervilliers
Bobigny
Romainville
Creteil
Maisons
Antwerp
BRUSSELS
Bruges
Ghent
Ostende
Calais
Strait of Dover
Lille
Roubaix
Tourcoing
Dunkerque
Leige
Namur
Charleroi
Mons
Düsseldorf
Cologne
Aix la Chapelle
Bonn
Coblenz
LUXEMBURG
Luxemburg
Metz
Strassburg
Nancy
Colmar
Mulhausen
Freiburg
Müllheim
Basel
Zurich
St.Gall
Constance
Lake of Constance
Berne
Lausanne
Geneva
Lake of Geneva
Bernese Alps
Pennine Alps
Mt.Blanc
Graian Alps
Cottian Alps
Maritime Alps
Ulm
Augsburg
Munich
Innsbruck
AUSTRIA-HUNGARY
SWITZERLAND
Bergamo
Verona
Vicenza
Milan
Novarra
Turin
Asti
Alessandria
Piacenza
Parma
Bologna
Genoa
Spezia
Savona
Cuneo
Pisa
Florence
Leghorn
ITALY
GULF OF GENOA
LIGURIAN SEA
CORSICA
Bastia
Ajaccio
Bonifacio
Strait of Bonifacio
Cape Corse
Elba I.
Pianosa I.
Monte Cristo
Capraja I.
Gorgona I.
GULF OF LIONS
MEDITERRANEAN SEA
Marseilles
Toulon
Iles d'Hyeres
Nice
Cannes
Montpellier
Beziers
Nimes
Avignon
Lyons
St.Etienne
Grenoble
Dijon
Besancon
Troyes
Reims
Chalons s. Marne
PARIS
St. Quentin
Amiens
Orleans
FRANCE
PICARDY
ARTOIS
CHAMPAGNE
LORRAINE
BURGUNDY
FRANCHE COMTE
LYONNAIS
DAUPHINE
SAVOIE
PROVENCE
LANGUEDOC
AUVERGNE
BOURBONNAIS
NIVERNAIS
ROUSSILLON
Perpignan
Gerona
4° Longitude East from Greenwich 6°
8°
10°
12°
50°
48°
46°
44°
42°

south its harbors in the Mediterranean secure to it a large share in the traffic of that most important of all inland seas. France is traversed from southwest to northeast by several chains of mountains forming the general water-shed of the country. This water shed has two slopes, the one toward the west and north, carrying its waters to the Bay of Biscay, the Atlantic Ocean, the English Channel, and the German Ocean; the other toward the east and south, carrying its waters to the Mediterranean. The ranges of mountains and hills forming this water shed include the western and central Pyrenees, the western Corbières in the department of Aude, the Cevennes, the mountains of Vivarais, Lyonnais, Beaujolais, and Charollais, the Côte d'Or, the Plateau de Langres, the Faucilles Mountains, and the Vosges. This general water shed is met toward the northeast by the eastern mountain ranges of France, namely, the Jura range and various Alpine ranges, one of the peaks of which is Mont Blanc, which may be regarded as the culminating point of the European mountains, although not absolutely the highest mountain in Europe. Near the centre of France, and separate from the great water shed of the country, are several groups of volcanic mountains known by the general name of the Mountains of Auvergne, the chief peaks of which are the Plomb du Cantal in the southernmost group, the Puy de Sancy in the central group, and the Puy de Dôme in the northernmost group. The spurs thrown off by the great water shed divide France into six principal basins, five of which are on the northwestern slope, and one on the southeastern.

Rivers and Lakes.— The great rivers of France are the Seine, Garonne, Loire, Charente, Adour, Meuse, and the Rhône. In the basin of the Garonne are its affluents, the Ariège, Tarn, Lot, and Dordogne on the right bank, and the Gers on the left bank. To the north of the basin of the Garonne is that of the Loire and its tributaries, the Nièvre and the Maine on the right bank, and the Allier, Loiret, Cher, Indre, Vienne, and Sèvre Nantaise on the left. To this basin also belong the secondary basins of the Vilaine and the Blavet. In the basin of the Seine are its tributaries, the Aude, Marne, and Oise on the right bank, and the Yonne, Loing, Eure, and Rille on the left bank. The secondary basins are that of the Somme in the north, and those of the Orne and Oise in the south. In the basin of the Meuse are its tributaries, the Sambre on its left bank, to which is added the secondary basin of the Escaut or Schelde. The basin of the Rhône occupies the whole of the territory of France which lies to the southeast of the great water-shed. The tributaries of the Rhône are the Ain, the Saône, the Ardèche, and the Gard upon the right bank, and the Isère, Drôme, and Durance on the left. The secondary basins are those of the Var, Argens, and Arc on the east, and those of the Tet, Aude, and Hérault on the west. France has in all more than 212 navigable streams, with a total navigation of 5,700 miles. The lakes are few in number, and individually limited in extent. The largest, Grand-Lieu, in the department of Loire-Inférieure, covers an area of only 27 square miles, and is altogether devoid of interest. The next largest, St. Point, in the Jura, does not cover three square miles. Others of still less dimensions become more interesting from their localities in the lofty regions of the Pyrenees, or in the deep hollows of ancient craters in Auvergne.

Geology.— France possesses all the geological formations in a greater or less degree of development. The mountains generally have a nucleus of granite, which accordingly forms a prevailing rock in the Alps, on the east frontier, and their branches south to the shores of the Mediterranean, in the Pyrenees, the Cevennes, and the elevated plateau of Langres. In the Vosges it is more sparingly developed, its place being often occupied by porphyry; and in the Jura, where limestone occurs in such enormous masses as to have given its name to a peculiar formation. The other crystalline rocks, consisting chiefly of trachytes and basalts, have received a magnificent development in Auvergne, where whole mountains are composed of them, and where the effects of remote volcanic agency are still presented to the eye in extinct craters and lava streams. The granite is overlaid by primitive stratified rocks of gneiss, and of micaceous and argillaceous slates, succeeded, particularly in the Pyrenees, by mountain limestone. The secondary formation, commencing with this limestone and continued in ascending series up to the chalk, always possesses peculiar interest, because within it valuable mines of lead and iron, and all the workable seams of coal, are included. It is largely developed in many parts of France, and furnishes a considerable number of coal and mineral fields. The Tertiary formation, including all the limestones, sands, and clays, above the chalk, occurs continuously in two great divisions, and partially in a number of isolated spots, and covers a vast extent of surface. The larger continuous division is in the southwest, where it commences at the foot of the Pyrenees, and occupies a very large portion of the basins of the Garonne and of the Adour. The lesser but better known division takes the name of the Paris basin, and has been made familiar to the scientific world by the labors of Cuvier and other distinguished naturalists.

Climate.— The climate of France is greatly diversified, and cannot be described accurately without dividing it into different regions. With a very limited exception, it lies wholly within the more moderate portion of the temperate zone. France may be divided into four climatic regions according to the different vegetable products which different districts are able to mature. Within the first, and warmest, the olive is successfully cultivated. It forms the southeast part of France, and is chiefly confined to the departments which border on the Mediterranean. The second region is characterized by the general cultivation of maize or Indian corn. The third region reaches north to the extreme limit of the profitable culture of the vine, and may be considered as determined by a line stretching between the mouth of the Loire and the town of Mézières, in the department of Ardennes. All the country beyond this line is included in the fourth region. In the northwest the prevalence of winds from that direction often produces a superfluity of moisture, which manifests itself in mists or in frequent and heavy showers of rain. At the opposite extremity, the southeast, a contrary effect is produced, and a sultry, stifling wind wrinkles up the skin, and not unfrequently spreads fever in its most malignant form. But it is only to a few exceptional districts that these remarks apply. After allowing for them, more than four fifths of the surface remains, under an atmosphere remarkable, more especially in its central districts, for salubrity, serenity, and brightness.

Political Divisions.— Before the revolution of 1789 France was divided into general governments, the number of which has varied at different epochs. Under Francis I., by whom they were instituted, there were 9. Under Henry III. there were 12. Under Louis XIV. the number was fixed at 32, to which a 33d was added by the acquisition of Corsica, under Louis XV. In 1789, when the love of change became paramount, the provinces were not permitted to escape; and it was then determined that the whole of France, including the island of Corsica, should be parceled out into departments, and each department subdivided successively into arrondissements, cantons, and communes, an arrangement which was actually carried out in 1790. This division has since maintained its ground, each department being named after the most important physical feature which it contains. The number of departments was originally 83, but it has been at different times increased and decreased. There are now 87 departments, the last formed being Haut-Rhin (Belfort). As the old provinces, though no longer recognized in legal and other formal documents, continue so familiar to the French themselves, and are so frequently mentioned, not only by earlier writers, but in the geographical, historical, and statistical works of the present day, a table is here given exhibiting these provinces in alphabetical order, and in parallel columns, the chief town in each, and the departments most neavly corresponding to them:

Provinces	Departments	Capitals of Provinces
Alsace	(Now German, except Belfort, or dep. Haut-Rhin)	Strasbourg (German)
Anjou	Maine-et-Loire	Angers
Artois	Inland or southeastern portion of Pas-de-Calais	Arras
Aunis	Maritime part of Charente-Inférieure	LaRochelle
Auvergne	Puy-de-Dôme and Cantal	Clermont
Béarn-et-Navarre,	Basses-Pyrénées	Pau
Berry	Cher, Indre	Bourges
Bourbonnais	Allier	Moulins
Bourgogne	Ain, Côte-d'Or, Saône-et-Loire, Yonne	Dijon
Bretagne	Côtes-du-Nord, Finistère, Ille-et-Vilaine, Loire-Inférieure, Morbihan	Rennes
Champagne	Ardennes, Aube, Marne, Haute-Marne	Troyes
Corsica	Corse	Ajaccio
Dauphiné	Hautes-Alpes, Drôme, Isère	Grenoble
Flandre	Nord	Lille
Foix	Ariège	Foix
Franche Comté,	Doubs, Jura, Haute-Saône	Besançon
Gascogne-et-Guyenne	Aveyron, Dordogne, Gers, Gironde, Lot, Lot-et-Garonne, Landes, Hautes-Pyrénées, Tarn-et-Garonne	Bordeaux
Ile de France	Oise, Seine, Seine-et-Oise, Seine-et-Marne, southern part of Aisne	Paris
Languedoc	Ardèche, Aude, Gard, Hérault, Haute-Garonne, Haute-Loire, Lozère, Tarn	Toulouse
Limousin	Corrèze, Haute-Vienne	Limoges
Lorraine	Meuse, Vosges, Meurthe-et-Moselle (and German Lorraine)	Nancy
Lyonnais	Loire, Rhône	Lyon
Maine	Mayenne, Sarthe	Le Mans
Marche	Creuse	Guéret
Nivernais	Nièvre	Nevers
Normandie	Calvados, Eure, Manche, Orne, Seine-Inférieure	Rouen
Orléanais	Eure-et-Loire, Loiret, Loir-et-Cher	Orléans
Picardie	Somme, maritime part of Pas-de-Calais, N. part of Aisne	Amiens
Poitou	Deux-Sèvres, Vendée, Vienne	Poitiers
Provence	Basses-Alpes, Bouches-du-Rhône, Var, eastern part of Vaucluse	Aix
Roussillon	Pyrénées-Orientales	Perpignan
Saintonge and Angoumois	Charente and eastern or inland part of Charente-Inf.	Angoulême
Touraine	Indre-et-Loire	Tours

The following territories have been acquired since 1790:

Territories	Departments
Avignon and Venaissin (including Orange previously acquired)	Part of Vaucluse
Nice	Alpes-Maritimes
Savoie	Savoie, Haute-Savoie

Agriculture.— About nine tenths of the soil of France is productive, and about one half of the whole French territory is under the plough. In regard to the management of arable land, the French are still far behind the English, but have nevertheless made great advances during the 19th century. During the last 50 years the production of cereals in France has increased by nearly 70 per cent, while the extent of land under cereals increased by only one quarter. This is equivalent to saying that the productiveness of the soil has increased in that time by fully one third. The cereals forming the great bulk of the cultivated crops are wheat, oats, rye, and barley. The crops next in importance to these are meslin or mixed corn, potatoes, hemp, rape, maize, buckwheat, flax, and beet. This last plant is cultivated extensively in some departments, especially in that of Nord, for the manufacture of sugar. The most valuable crops of which the cultivation on a great scale is not general, but confined to particular districts, are madder, tobacco, saffron, and hops. The cultivation of tobacco is monopolized by the government, and is confined to certain departments. It yields an annual gross revenue to the government of about $75,000,000, but from this total there falls to be deducted the expense incurred in the cultivation and manufacture of the tobacco. In France the grass is on a much more limited scale than the arable husbandry, the land in permanent meadow being in extent only one sixth of that under the plough. The breeding of stock, notwithstanding the stimulus afforded by the establishment of numerous societies, general and local, for its encouragement, is, in France, if not imperfectly understood, very indifferently practised. The races of oxen, instead of being confined to a few of the more perfect types, are almost as various as the different districts into which the country is divided, and include a few good breeds, particularly in the rich plains of Lower Normandy. The rearing of sheep is more successful, and much wool, scarcely inferior to that of the merino, is raised. The general employment of cattle for agricultural purposes gives little encouragement to the rearing of draft horses; but the warlike propensities of the nation have always created an extensive demand for horses. Asses and mules, generally of a superior de-

THE COLUMN OF JULY, PARIS.

scription, are much used in France. The cultivation of the vine is one of the most important branches of French agriculture. The total quantity of land in vineyards is nearly a twenty-fifth of the whole surface; but as there are extensive and continuous districts where there are no vineyards, the proportion which vine-land on the districts properly adapted to it bears to the whole land under cultivation, attains a much higher ratio. The various first-class wines, under the name of Champagne, Burgundy, Bordeaux, etc., are in high repute and general demand over all Europe. France produces about 1,700,000,000 gallons of wine annually. A large part of the wealth of France consists in its fruits. Among the most important fruit-trees are the apple, the fruit of which, in the northern districts, particularly in Normandy, is largely used for the manufacture of cider; the chestnut, which, in barren districts, yields an article of food which takes the place of the cereals among the poorer classes; the mulberry-tree, cultivated in 8 or 10 departments in the southeast, both for its fruit and its leaves, the leaves being used as food for the silkworms, on which the French silk manufacture depends; the olive, which grows in the same districts as the mulberry; the pear, plum, cherry, apricot, peach, orange, citron, fig, almond, etc. In France but 18 per cent (36,700 sq. m.) of the surface of the country is forest land. This includes what is really «bush» land. In the region of Paris are the Forests of Fontainebleu (66 sq. m.), of Compiègne (56 sq. m.), of Rambouillet, etc. The largest forest in France is the Forest of Orleans, covering about 145 square miles. The mountains and plateaus of the east and northeast of France form the best wooded parts of the country, embracing the forests of Ardennes, of Haye, of Argonnes and the pine forests of the Vosges and the Jura, including the Forest of Chaux. About one third of the forests of France is the property of the state, the communes and of public institutions. The remainder is in the hands of private owners, but subject to governmental restrictions. The branch of the Ministry of Agriculture known as the Department of Waters and Forests is administered by a director-general. He has three assistants, with headquarters at Paris, and to whom is confided the settlement of all questions of law and rights, finance, etc., and all the workings of forest lands. The department is supplied with higher grade officials from the National School of Waters and Forests at Nancy, founded in 1824. These comprise 32 conservators each controlling a district composed of one or more departments, 200 inspectors, 215 subinspectors, and about 300 guards. In addition there are several thousand other employés, including an army of forest-rangers. The Ministry of Agriculture is assisted by a council of 100 composed of senators, deputies, and agriculturists. The ministry comprises the following divisions: Agriculture, which supervises agricultural instruction and the distribution of premiums and grants; agricultural improvements, including irrigation and draining; an information department, which prepares statistics and issues bulletins as to markets, prices, etc.; waters and forest; breeding studs. The ministry employs inspectors to visit the different parts of the country and report on their respective needs. These reports assist the state in distributing the money dispensed to agricultural societies, etc. Among the premiums awarded by the state are those for irrigation works, the best cultivated estates and for the best stallions and brood-mares. Stallion stables containing over 3,000 horses are established in 22 towns which annually send stallions to various stations throughout the country where they are at the disposal of individuals for a small fee. The state also maintains a sheep-fold at Rambouillet (Seine-et-Oise) and a cow-house for the breeding of Durham cows at Vieux-Pin (Orne). Under state control are four grades of institutions for agricultural instruction: Farm and dairy schools to which the age of admission is from 4 to 16 years of age; practical schools for the sons of farmers from 14 to 18 years of age; national schools at Grignon (Seine-et-Oise), Rennes, and Montpellier, for boys of 17 years; the National Agronomic Institute at Paris for the training of professors, estate agents, etc. There are also departmental chairs of agriculture; the holders of the chairs give instruction in training schools and advise farmers.

Mineral Resources.— The coal-fields of France are so numerous that coal-pits exist in no fewer than 33 departments; but most of these are very limited in extent. Several of the smaller fields occur in the northwest, and also in the south, where both anthracite and lignite are found; but the fields whose importance entitle them to particular notice are only two — that of Valenciennes in the northeast, forming the western extremity of the great Belgian coal-field, and that of St. Etienne, to which the manufacturers of that town, Lyons, and the surrounding districts, are indebted for much of their prosperity. The annual output is over 30,000,000 tons, but falls so far short of the annual consumption that a large import takes place from England and Belgium, and wood continues to be the common fuel throughout France, at least for domestic purposes. The coal-fields contain seams of iron, which are extensively worked, and furnish ore to a great number of blast-furnaces. Though the number of mines actually worked is great, the quantity of foundry pig annually produced is only about 2,500,000 tons. Few countries have been said to be so rich in lead as France. It occurs in greater or less quantity in a great number of districts, and is generally argentiferous. Manganese is very widely diffused, but is worked only in a few mines. Gold exists both in the sands of rivers and *in situ* in thin streaks embedded in quartz. Attempts have been made to work it, but not with success. A vein of quicksilver was opened about the middle of the 18th century, and was worked successfully for 12 years, and then abandoned. Zinc, copper, arsenic, nickel, and cobalt exist, but not in such quantities as to be workable to profit. The principal saline substances are alum and common salt. The great sources from which salt is derived are the lagoons and salt marshes which line many parts of the coast. Of these the produce is about 300,000 tons. A large revenue is also derived from quarries, and beds of common clay, potter's earth, and kaolin.

For information concerning HISTORY, GOVERNMENT, SOCIALISM, EDUCATION, RELIGION, etc., see the following special articles.

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Agrégé de l'Université; Docteur-ès-Lettres; Professor of Philosophy; Officer of the Académie

15. Army and Navy .... Lieutenant-Colonel Rollin
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16. Railways .... M. de St. Amand
Engineer to the Chemin de Fer du Nord

17. Industries .... Alfred Renouard
Editor of 'l'Industrie Textile'

18. Commercial and Banking System .... Joseph Delcourt
Agrégé de l'Université; Professor in the Lycée of Montpellier

19. Colonies .... Charles Lemire
Résident Honaire de France; Chevalier of the Legion of Honor

FRANCE:

HISTORY AND MODERN DEVELOPMENT.

1. **French Civilization.** Nationality does not consist in a race, still less in the use of a common language, but in the possession of a corporate tradition. A nation is a body of men distinguished from other bodies around it by the possession of an organic tradition which so moulds the habits of life of those subjected to it as to define them clearly from their neighbors.

The territory the larger part of which is now called France, and the ancient name of which was Gallia, has, since the beginning of recorded history, been inhabited by many million men possessed of and influenced by such a corporate tradition which has given unity to their commonwealth even in its most anarchic or barbaric periods, and which permits us therefore to speak of the French people as of a permanent historical phenomenon in Western Europe. Compared with this solid and recognizable truth, guesswork upon complicated racial origins and still vainer guesswork upon the evidence of language, are negligible.

The characteristics which the Gauls have developed in this national tradition of theirs and which in turn their national tradition has imposed upon them and confirmed them in, are easily recognized by the modern traveller or by the student of the detailed history of the last 300 years. This tradition comports energy working at a very high potential, a potential so high as sometimes to fuse its communications, and so high as to suggest to those unused to it a necessary absence of volume. It comports in philosophy a combination, somewhat paradoxical in character, by which material and tangible things are chiefly regarded and yet treated by the methods of pure thought. Thus no nation has expressed political theory in terms more general than the French, yet none have had less inclination for metaphysics.

In the political sphere the national tradition of which I speak is essentially military, and in the various forms of its expression has never ceased to be so,—by which is not meant that the French are perpetually under arms, or chiefly concerned with making war, but that their conception of the organization of a State is always a military conception; and that as the art of war changes and develops, now tribal, now municipal, now based on castles and at last national, so has Gaul been a loose hierarchy of tribes, a web of Roman municipalities and garrisons, a tangle of feudal relations, or a highly centralized and bureaucratic body. The whole trend and determination of the French mind in civics may be expressed in the formula «Without authority there is no life.» It is on this account that throughout French history promptitude and power are demanded from Government, and that among a people to whom the Oriental ideal of collectivism is highly repugnant, so much is demanded from the State and so many of a citizen's actions are considered only in the light of his relation to the State, as though the duties which he owed to the State were in some way more sacred than the rights which the State should guarantee to himself.

The minor and more superficial characteristics that go with this general picture, are a vivacity and often an excellence in oratory, an exact and somewhat excessive precision in daily life, accompanied by an excessive neglect of such details as are considered unimportant, which neglect is repulsive to those who carry a less precise order more generally over the whole of life; a considerable artistic faculty, waning and waxing with various periods, but fairly constant in dramatic art and in architecture; a lack of appetite for individual adventure (a trait in which the Frenchman contrasts very sharply with the Scandinavian and the Islander of the North, whether Irish, Highland, English or Dane); and finally, a curious power of common action often suddenly inflamed and always extreme, in which the Frenchman contrasts not only with the Scandinavian spirit upon the North of him, but also with the various Germanies, the Spaniards, and Italians of his frontiers, and indeed with every other European community. It is to this trait that France owes the many popular risings and massacres to be discovered in her history, the extreme rapidity with which a leader is chosen and again rejected, the lack of judgment in foreign affairs which cannot but accompany the confused action of a great number of men, and the startling military successes which that common action often produces. Of these of course the main historic examples are the great Eastward march of the Gauls in the third century before our Lord, which led them to the sack of Rome and of Delphi, and to a permanent colony in Asia Minor; the march of the Crusades, and the wars of the French Revolution. But beside these enormous swarmings of the French, innumerable minor phases of the same type are to be discovered in the 2,000 years of Gallic history. It is to be noted also that just as the French are unique in expeditions of this kind, so are they unique in the multitude of their civil wars.

The good or evil of these characteristics I do not propose to examine, nor can they I think be determined; for they will vary according to the very various ethical systems which abound in the modern world, and every reader will determine for himself whether he approves or disapproves of the Gallic temper. It is such as I have described it.

It will next be remarked that the French, such as they are, have had since the fall of the Roman Empire, a very large and disproportionate influence upon the mind of Europe. This truth is so generally appreciated that it needs no expansion here, but a few examples will make it evident to all. French has been the language of a governing class from the River Tyne to the River Euphrates, and from the Atlas Mountains to the mouths of the Rhine.

Feudalism and the whole structure of mediæval society, was Gallic in its origin. The Gothic architecture is a Gallic invention, as is the collegiate university. The systems of military fortification in the 12th, in the 16th, the 17th and the latter 19th centuries, are French; the French framed the first code of laws since the fall of Rome—it became at once the basis for every code throughout Europe. The French road is the model of the German and the Italian road, and to-day the weights and measures of European civilization are French; while, to mention a detail of no great importance, the French language becomes, with every year, more and more the medium of international communication and especially the medium in which is expressed the general result of European thought.

This permanent and, as it would seem, undue preponderance of the French mind, is in part no doubt due to the mixture of excessive energy with excessive precision which is the vice, or virtue, of the French. But a very large part, and the more easily ascertainable part of this influence, must be laid to causes of another kind,—causes more material and dependent upon the sequence of history outside the frontiers of Gaul, and the geographical position of the quadrilateral which the French inhabit; as also to some extent to the influence of soil and climate.

In order to appreciate these measurable causes of French preponderance, let us examine the boundaries of that quadrilateral, and estimate its physical qualities and its historical position.

The French, as I have said above, inhabit *nearly* all the territory anciently known as Gaul, and the boundary which may be set to the Gallic temper runs as follows:

Taking first a point upon the shores of the Bay of Biscay some twenty miles north of the Spanish frontier, the Atlantic Coast is the boundary until the Bay of Quiberon is reached; from that point upon the coast of Brittany the line drawn vaguely north and south to the coasts of the channel, excluding to the East the highly different Armorican type which, if place names and folklore are any guide, has probably lain permanently beyond this boundary since a period prior to the Roman invasion. From the point upon the channel so determined, the boundary proceeds eastward and northward along the coast (including the Channel Islands and their dependencies) to a point about half way between Calais and Dunquerque. Thence it strikes inland, including such places as Tournai, Mons, Charleroi, Namur, Liege, but a few miles east of the latter town and somewhat west of the old castle of Limburg the boundary turns sharply to the south and in a somewhat undulating form, after striking the Belgian frontier at Gouvy, runs a trifle west of that line, passes a mile or two east of Arlon, about half way between that town and the frontier, and so reaches the point where France, Luxembourg and Belgium meet, a point in which artificial and political boundaries curiously correspond with real divisions of men.

The limit of which I am speaking next follows the short Luxembourg boundary, and cuts in a line less defined than most parts of its course from the top corner of Lorraine to within a march or so of the Rhine.

This section is difficult to define, from the fact that the population is not possessed of sharply marked characteristics. Between the Gallic belt of Belgium and the non-Gallic, a boundary as sharp as that made by a river or a wall, can be discovered by the most superficial observer. There is more difference between Liege and Maestricht than there is between, let us say, an Irish and an English town. But in Lorraine no such sharp differentiation of architecture, manners and general way of life is to be discovered. Language is no guide here, the habits and aspect of a German-speaking village are the same as those of a French-speaking village, and one can only speak of a gradual transformation from the purely French town of Metz to the purely German belt which extends, as I have said, to within about one day's march of the Rhine. The belt between can only be described as mixed.

An exact boundary begins again in the neighborhood of Saverne, and follows the crest of the Vosges Mountains, the valleys and Alsatian plain to the east of which seem never to have been impressed with the Gallic type of culture; but whether under the dominion of the Government at Paris, or autonomous, or under the dominion of the Government of Berlin, or of foreign or of native lords and bishops, to have been other than Gallic in temper, and resembling in historic times any one of the minor subdivisions of tribal Germany.

Across the gap of Belfort the line runs just barely including that fortress a few hundred yards to the east of whose town boundaries everything, from the aspect of agriculture to the gait of the peasants, ceases to be French.

The line next proceeds to the peculiar isolated peak known as the Mont Terrible, runs down the middle of the Jura valleys, and from the end of that range of mountains can again with difficulty be determined; the great mass of mountains which lies between the gap of Geneva and the Mediterranean, may justly be regarded as less French in character than the Italian valleys upon the farther sides. French influence and culture and the march of French armies have more deeply affected the Val d' Aoste for instance, than such remote villages of Savoy as Lagrave. But one may say in general that it is safe to exclude Geneva and to include most of the mountain mass lying south of that town until the Mediterranean is reached. The shores of that sea continue the boundary so far as the neighborhood of Perpignan, and though the Catalan language and the Provençal, the highly differentiated climate and the long Roman tradition of this belt make

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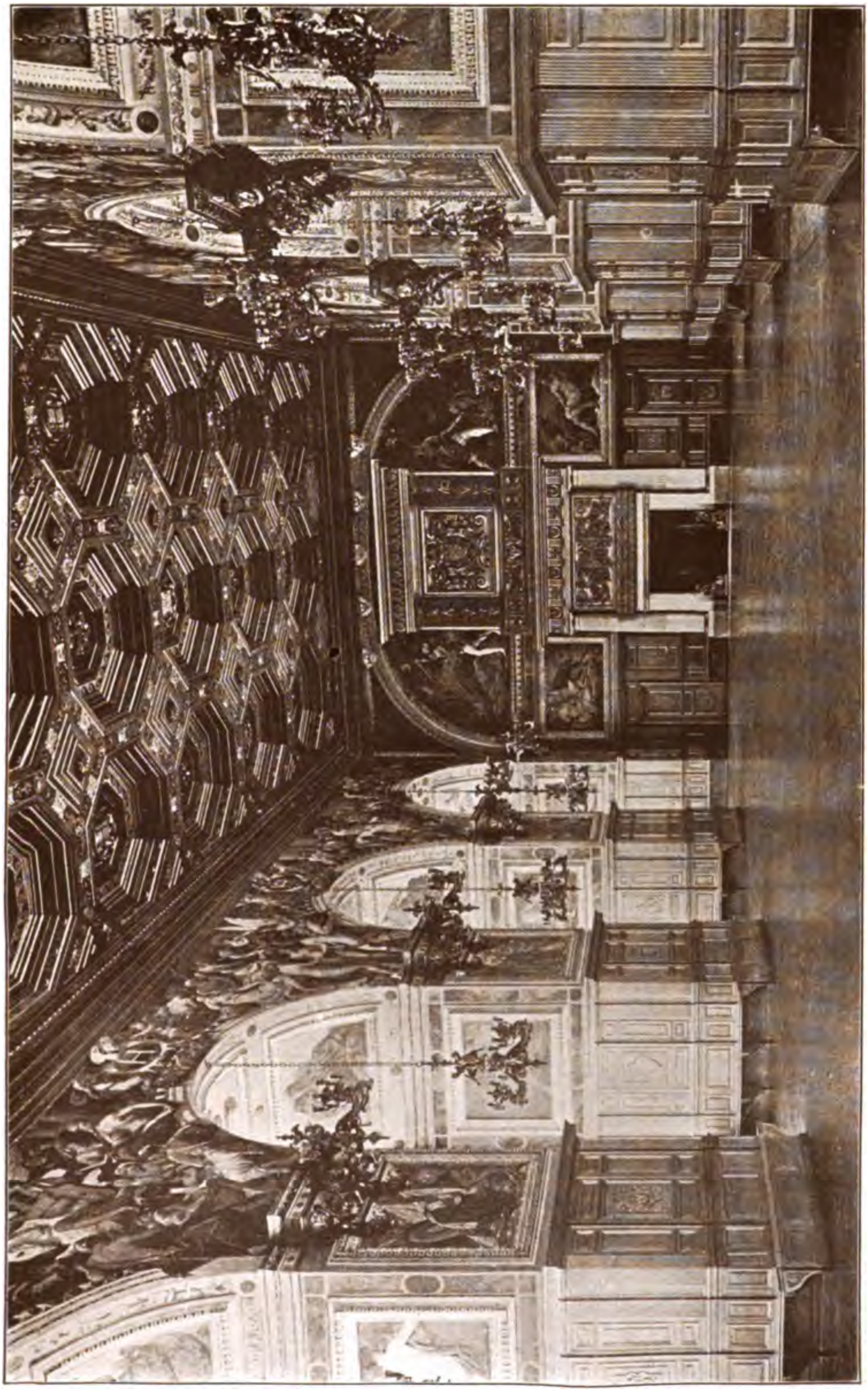
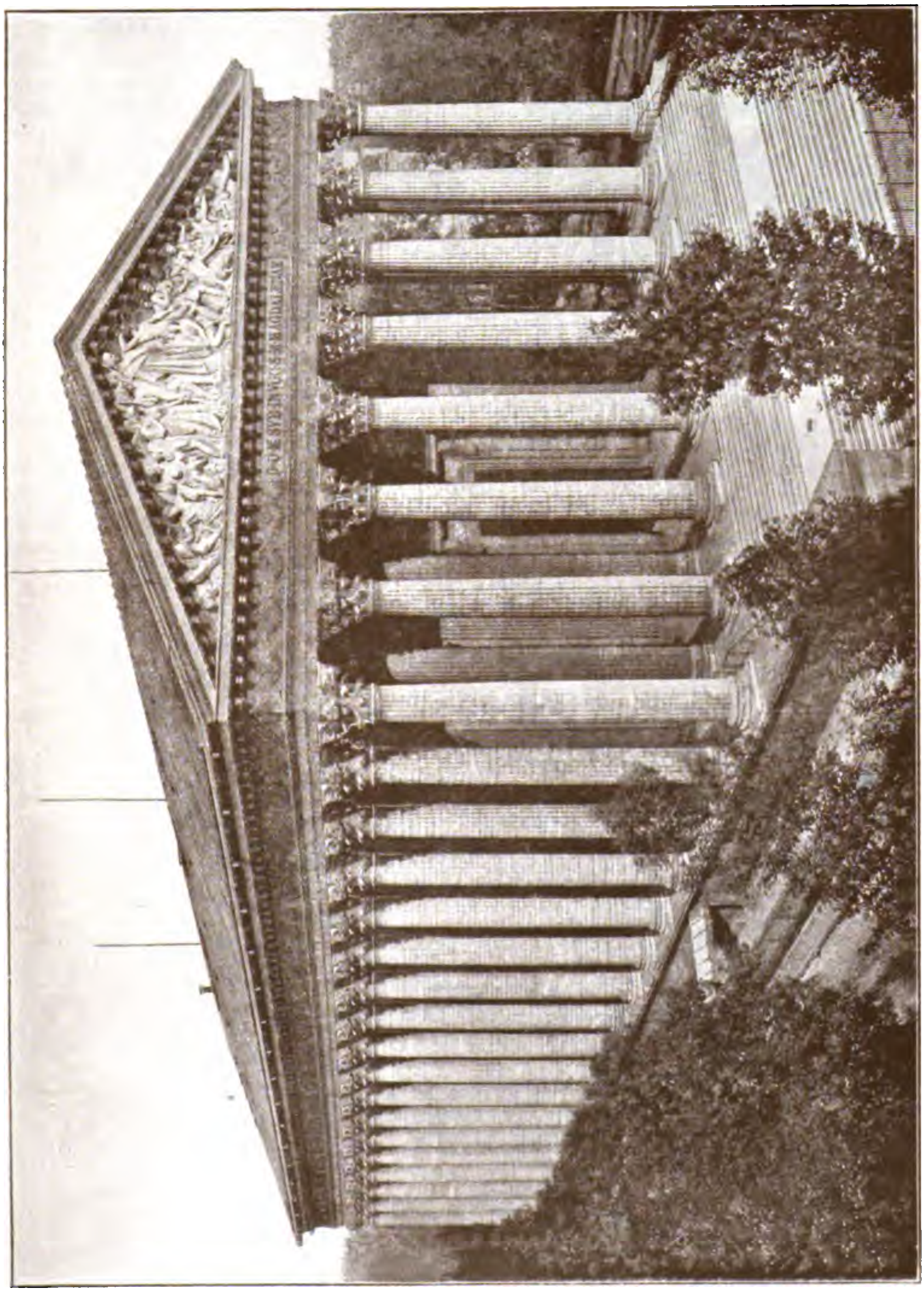


GALLERY OF HENRY II., PALACE OF FONTAINEBLEAU.

FRANCE.



CHURCH OF THE MADELEINE, PARIS.

it a thing somewhat apart in France, yet we must recognize the sea as the boundary of Gaul with the exception of a still remaining foreign influence in the town of Marseilles.

In the neighborhood of Perpignan as I have said, and a little before the Pyrenees are reached, the limit which we are defining turns westward and follows the northern base of the hills. So thorough has been the work of French governments since the Revolution, that the valleys running up from that base to the crest of the Pyrenees are, with one exception, now completely transformed in their superficial aspect and seem as French as any other part of the country; but no one well acquainted as is the present writer with the Pyrenean chain can question the identity of the inhabitants upon either slope. Beneath the surface of the modern French system, the manner and cultivation of these valleys is a foreign thing. And the line which we are following may be said, for instance, to include the Canigou and Mont Louis, but not the French Cerdagne; Aix, but not the sources of the Aiège; Bagnieres but nothing beyond it; Tarbes, and perhaps Lourdes but nothing south of Lourdes, and so on all along the chain until, a few miles after the passage of the Adour, the total separate Basque country is reached, where the line strikes northeast and reaches the point upon the Bay of Biscay from which we began to trace it.

It will thus be seen that the political boundaries of France to-day do not exactly correspond to the territory which we are considering, and which as a whole represents the physical basis of the French nation. That territory overflows the political boundaries towards Belgium and Germany, and is within those boundaries in much of its southern and southeastern part as also in the Armorican peninsula. And this lack of identity between the political and the real boundaries of Gaul has existed throughout recorded history. Thus the Romans took the convenient line of the Rhine upon the East, although the German tribal customs, dialect and general traditions have always existed in a wide belt upon the left bank of that river; and again the nominal suzerainty of the King of Paris (though that is hardly a test) for long excluded Bar-le-Duc, which is as French as Canterbury is English.

When the student sees upon the map of Europe the position occupied by this quadrilateral, he may wonder how that position can be called in any way preponderant. It is apparently but a fraction of the great European area, a fraction thrust far to the West, and occupying no central radiating position. The modern map, uninterpreted by history, and by the known effect of climate, leaves inexplicable the material cause of French preponderance. But an examination of these historical and climatic conditions goes far to explain it, and of the two the historical, which is the more important, should be taken first.

European civilization is not a material spread out evenly from the Ural Mountains to the Atlantic and from the Frozen Sea to the Mediterranean; it is an influence whose general expression is Roman, whose permanent seat is within the old boundaries of the Roman Empire, and which while it has radiated eastward and northward of those boundaries through the influence of the Christian missionaries, loses its intensity as a general rule the further it proceeds from its original seat.

This Roman unity was broken by the Adriatic into two halves, originally widely differing and as the centuries proceeded differing yet more widely. In the eastern half (the Balkan peninsula, Egypt and the Levant and Asia Minor) old and stable civilizations, had accepted the hegemony of Rome. The language of the generality of men was Greek, their interests were those of a very aged and perhaps a somewhat exhausted civilization, whose origins went back to the remotest eras, and whose high art and exquisite literature was already in perfection in epochs long anterior to the furthest records of history.

In the West, Latin was the general tongue, though for long the educated and wealthier classes were bi-lingual. And there the Roman genius taught and produced a new civilization common to the Iberian, the Gaul and the Briton, to the Kabyle of the Atlas Mountains, and to the German of the Rhine Valley, introducing to all these people a common art, a common tongue and law, and a common happiness. The boundaries of this Latin unity are very clearly determined: A line drawn from Glasgow to Edinburgh including both those cities shows us what part of the British islands enjoyed this benefit, Wales, the Lowlands and England. The Netherlands, south of the Rhine delta, all the lower left bank of the Rhine, and in its upper reaches both banks,—all the valley of the Upper Danube and the mountains of the Tyrol. All North Africa, from the Bight of Tunis to Tangiers; all Spain and all Gaul,—had in common the vine, the mass, the arch, the column, the municipium, the military way, and were one thing.

Now if this boundary be drawn upon the map it will at once be perceived that Gaul was the centre of gravity, so far as mere area was concerned, of the whole system. And to this mere material fact, important though it was, there was soon added a series of historical accidents which very greatly emphasized this central position.

In the same period which saw the flowering of Roman thought into a definitely Catholic civilization, the long transformation of the Roman army was accomplished. It had become an hereditary and a mercenary thing, drawn largely from those populations which did not enjoy the full civilization of Rome and which were therefore ready to accept a wage more easily than would the free citizen of the Empire. Through the agency of these armies, in a most confused manner, the barbarian pressed more and more upon the civilized area, and he pressed upon it, though never in large numbers yet always with an energy that varied from an infiltration like that of the Franks or the Burgundians to a savage incursion like that of the pirates who overran the eastern part of Britain.

A little later than the first series of these catastrophes the Mohammedan religion suddenly united the non-Roman desert tribes to the South and these destroyed the civilization of Northern Africa which had already been weakened by an anarchy of wandering Germans, revolted slaves, and what not, and finally, by the 8th century the principal islands of the Western Mediterranean, nearly all the Iberian and the ports of Southern Italy were occupied by the Saracens.

The test of Roman, that is of civilized, continuity, is the authority of the town, with its bishop as the successor (he had once been the coadjutor) of the civil authority. And side by side with this test is a secondary one, namely, the authority of the Palatine Writ: of the Writ issued in Latin from the palace (a word borrowed from the Palatine Hill at Rome) wherein resided the centre of government. Now if we take a map of Western Europe as defined within the old Roman limits, and shade with a pencil those Roman municipal areas which lost such a continuity of episcopal government and Palatine, Latin, authority, we shall find that this shading will leave us nothing but Northern Italy and Gaul; and indeed, but for the exception which Northern Italy presents, the vast area of Gaul may properly be regarded as the only survival of Roman civilization in the West. From this survival, as from an unsubmerged rock in a flood, a platform could be made upon which the damaged conditions of civilization might be rebuilt and from which the influence of civilization could again radiate.

The transformation of Roman society when the recivilization of Western Europe began, had made it what is called «feudal.» The slaves had become serfs organized in co-operative agricultural communities; the great Roman landlords had become fighting nobles; from this type of society, in all its changes, onward until the Revolution, and through the Revolution to our own day, Gaul through every vicissitude has remained the pivot upon which the mind of Western Europe has turned. And if at the present moment French armor plating, French road making, the French system of fortification, the French organization of local government, French weights and measures, French field artillery, French submarines, French motor cars, French historians, and the dual polarity of French philosophy, Catholic and anti-Catholic, have imposed themselves upon Europe, this modern accident is but in the general and normal tradition of an historical condition necessary to Western Europe.

Apart from these human and therefore most important factors, certain merely material, limiting and therefore inferior factors must be considered. These will be discovered no less than those to conspire in favor of this permanent position of France.

Of material influences in Europe the two most considerable contrasts are the contrast between the Northern and the Southern type of climate, and the contrast between the tidal ocean and the nontidal Mediterranean.

A vast number of characteristics may be connected with either of these physical contrasts, and with either portion of each. That materialism which was the dominating note of the last generation and which is but slowly passing, regarded climate and such material considerations as we are now discussing as the principal cause of all the differences that could be discovered by the historian. No man would now lend himself to such crudities. The tribal system does indeed roughly contrast with the municipal, in the same way that North does against South, and those who use such terms as «Latin peoples,» etc., conceal beneath their ignorance an appreciation of certain obvious truths which may be roughly connected with climatic conditions. But apart from such speculations, certain very definite material results follow from the pair of contrasts I have mentioned. Thus, the rivers of Northern Europe are highways; they are usually placid and broad and fairly deep, and are penetrated by the tide far within the plains of that region. Even Scandinavia, which has no such rivers, enjoys the corresponding presence of fjords. The Rhone, the Ebro, the Chelif, the Tiber, the Po, the Adige, are not highways. The Seine, the Rhine, the Thames and the Trent, are. Again, the seaport in a tidal sea, to be of value must be chosen in a more particular locality than in a tideless one. Again, the North gives us longer if not fiercer storms. Again the beach in a heavy tide is less suitable for landing; a heavier type of vessel tends to develop, and with it the possibility of further adventures.

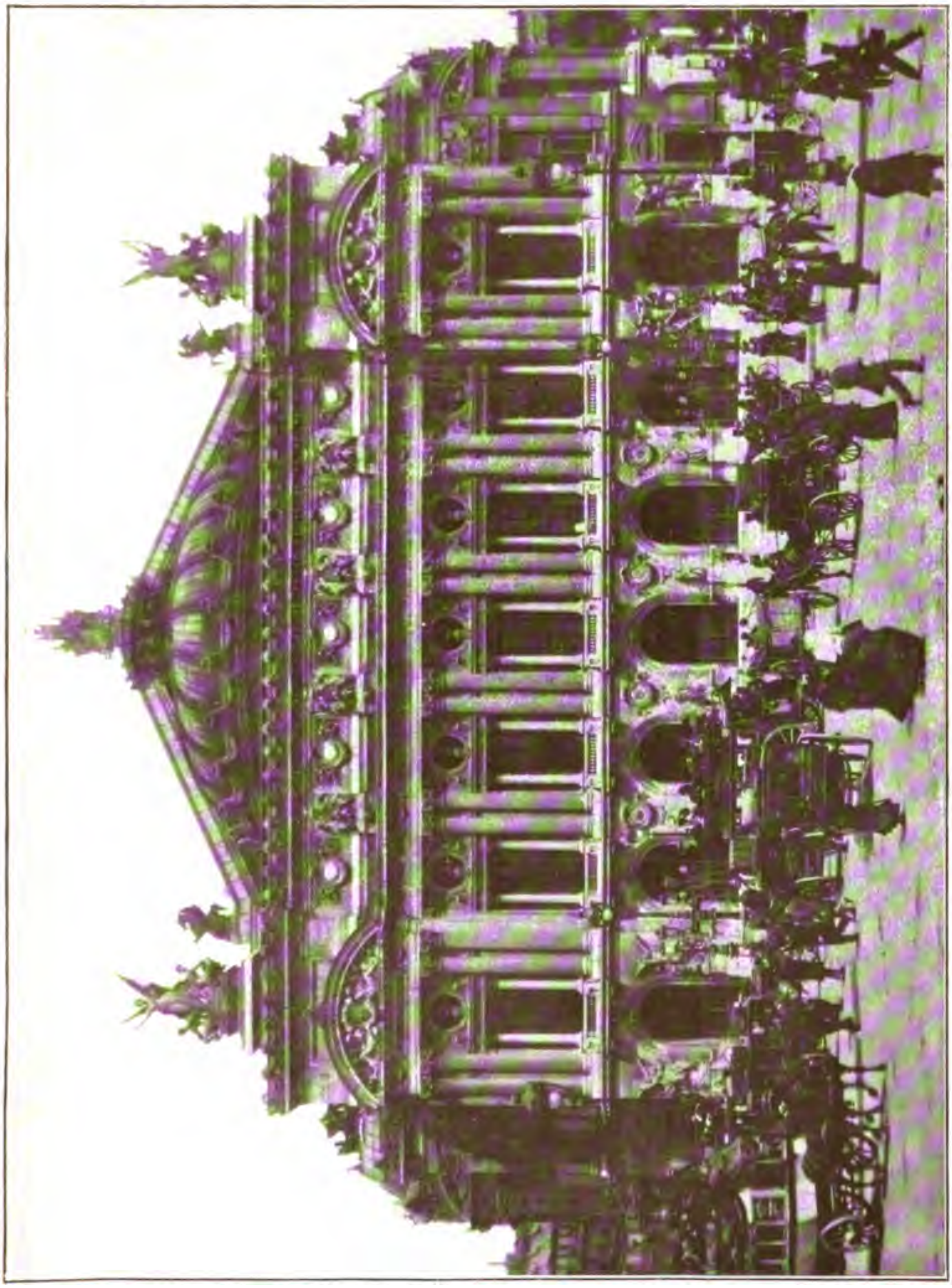
It is evident also that with difference of climate a different architecture, a different agriculture and different social habits will arise; and my point is that the contrast between the two zones in Europe is normally a sharp contrast. Nowhere does one feel it more strongly than in the passage from Switzerland of the German sort over or through the St. Gothard to Airolo. Between the two points which are but nine or ten miles apart, the whole of life appears to change.

Now Gaul affords the obvious link between these halves of civilization, and, typically enough, Paris, the capital, is in its aspect now a Northern and now a Southern town. It was southern under the Roman occupation, gradually grew northern again during the Dark Ages, and during the Middle Ages was purely Gothic without a vestige of the South about it (except that it was just on the limit of the wine-drinking country). Then again with the Renaissance it became again gradually the Southern thing which it is to-day.

Again, on a modern battleship, if it be German or English, you will have only the Northern type of man, accustomed as a rule to the tidal sea, with all the quality of seamanship developed under those conditions, while on an Italian battleship you will have men brought up as boys with the latine sail, the absence of tidal currents, the steeper seas, the sudden gust, and the long calms of the Mediterranean. On a French battleship you will have both types of men.

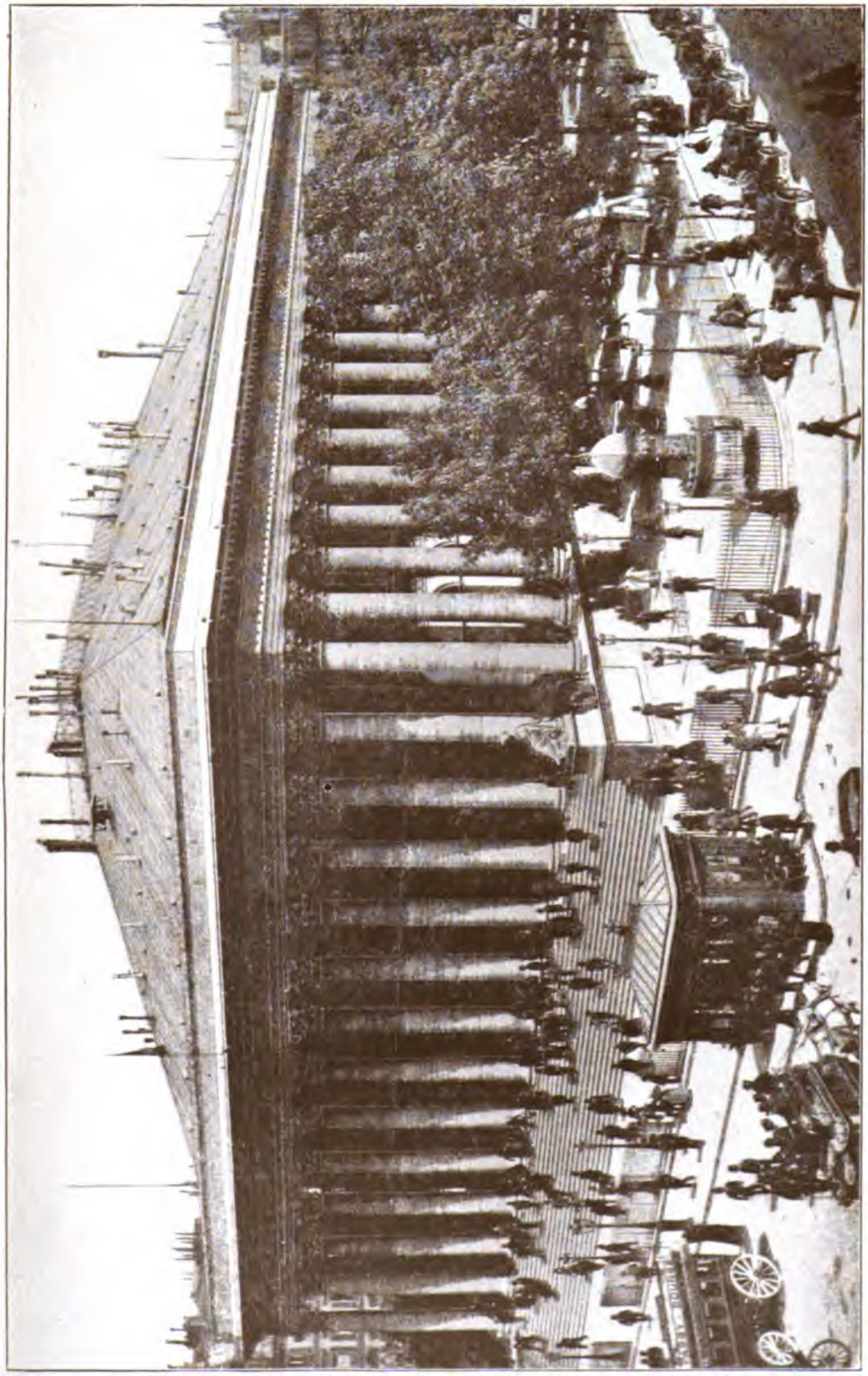
Consider again climate not by meaningless scientific terms of measurement, but as it is expressed in the common experience of life. In the South frost is rare, snow is rare; the long months of cold which render life difficult are not known save in the mountains. The south of Gaul is in this condition. It builds with a flat roof, it knows nothing of skating

FRANCE.



FACADE OF THE OPERA HOUSE AT PARIS.

FRANCE.



THE BOURSE (OR EXCHANGE), PARIS.

nor of the preservation of plants through the winter, nor of the isolation which cold elsewhere has produced in the past through long periods of the year. In the North all those conditions are as common a part of life as they are in Holland or in England.

In Northern Europe the sun is the grateful climate; in Southern Europe shade and coolness. In the Southern Europe a low relief was sufficient for plastic art; in Northern Europe a high relief. You find them joined in the art of Mediæval France.

Again, consider food. Wheaten bread is the staple of Roman civilization. To the north of it, oats, rye, and other poorer cereals; to the East, rice; and at this day France grows more wheat than any other of the western European states. France grows more wheat than Italy, England and Spain combined. She grows more than half of Europe, outside Russia. Next to wheat the vine has been the staple of French civilization in the matter of food, but the vine is not easily grown northward of a certain limit (though in the Middle Ages that limit extended far into Britain). Gaul, though mainly wine-drinking, includes a north-eastern belt which has the custom of Eastern Britain and the German tribes, and drinks beer, while it has a larger north-western belt which follows the custom of Western Britain and drinks cider.

So the northern use of butter, the southern use of olive oil meet in Gaul. The use of and the partial abstinence of flesh—which is largely a matter of climate—depend upon zones which also meet in that territory. Meat cannot be kept in a southern summer; a northern winter cannot healthily be passed without it.

The list of such contrasts could be drawn out indefinitely by any man of average travel and reading; and in nearly every one of them he would find that French territory was a common ground upon which either type met.

It is in the light of the foregoing general considerations that we must regard the history and character of the French people. They will continue to influence the future as they have influenced the past, and they are the major constants in every far-reaching problem of European importance. But a few closing words upon the immediate conditions of the French will perhaps enable the reader better to appreciate the articles that follow.

In general, those immediate conditions consist in this, that upon the general material of a people welded into their unity by ancient customs, and by a method of thought which they are incapable of abandoning, two considerable discussions are at work. Neither can ultimately affect the profound mass and structure of Gaul, but the victory of one of the two parties in either of these discussions, will considerably affect the form or mould into which that mass shall be thrown, and therefore inevitably will affect the general structure of surrounding Europe.

These two discussions are, the discussion upon the purely democratic state, and the discussion upon the authority of the Christian religion.

They are often confused, and nowhere more so than in France itself. But the connection between them is quite accidental, and no accurate conception of the position can be arrived at until each is regarded quite separately from the other.

The modern French experiment in democracy is, in the main, a reversion to the ideal of the old civilization of the Mediterranean. It contains no part of that anarchic ideal of individual liberty common in more rudimentary states: an ideal that inevitably ends in oligarchy and usually in plutocracy. The French experiment in republicanism is an experiment which presupposes a highly organized, a highly centralized and a powerful state, capable of crushing by a common effort all sporadic and particular energies which may be antagonistic to or even separate from the common life. And the experiment is an experiment and not an achieved one, because the machinery for such a state is so difficult to construct. The experiment has never been tried before and it may well fail. Democracies have existed in small city states usually dependent upon slave labor; they have endured indefinitely in small isolated agricultural states; they have never permanently existed in large states under conditions of high civilization. So long as the French experiment endures, so long the conception of democracy at least, and, to some extent, its forms and ideals, will be observed in Western Europe. And it is a matter of intense interest to watch the succeeding phases of the experiment, the moments when it seems nearly approaching success and the moments when the whole conception seems too unworkable for the complexity of the modern world. I repeat, the issue is by no means decided.

The religious question is a more profound and a more vital one. The whole fabric of French life and tradition is so closely interwoven with the Catholic Church that men who should put no credence in the divine origin of that Church would find their easiest temporal explanation for its existence in the action and nature of the French people. Its high centralization, its military defence throughout a thousand years, its rigid conception of dogma, its deductive philosophy, are Gallic, not Italian.

The French cannot therefore respect any revealed religion save Catholicism.

Wherever this conception of religion exists, its counterpiece and converse is rationalism. Rationalism had completely dominated the thinking part of the nation and the leaders of its action in the 18th century; indeed it is only since the middle of the 19th that the arguments against that position have gathered strength among the more cultivated classes of the country. Coincident with the maximum of this rationalistic wave, the French Revolution quarrelled in its first year with the political organization of the clergy; next the Revolution became identified with all the patriotism and all the energies of the people in the course of a long war, and by the time of the Restoration, a great body of French thought and French energy was definitely cut off from and antagonistic to the National religion. The quarrel between the two still endures. The attitude of many a French statesman towards the Catholic

Church in France is not one of neutrality, but one of active enmity proceeding from a conviction that the Catholic Church is not only the permanent enemy of human happiness and liberty, but also of the particular State which it is his function to guide. Conversely, more than one cleric, though of French extraction, has learned to regard the liberal institutions of his country as the necessary and permanent enemies of religion. There is no logical connection between the two ideas: there is but a chance historic association, but that association has acquired great strength with the passage of time and with the succession of some five generations of men who have seen the quarrel continually growing, and no perceptible end to it approaching.

Such are the main combatants in this struggle. But two other factors of importance are present, the Jew and the Huguenot. Neither of these bodies are numerous, but they happen each of them to be extremely wealthy and this wealth with all that it connotes, of education and of power in the Press, is thrown into the scale against Catholicism. It is impossible at this moment to say what the end of the struggle will be. It is only certain that if Catholicism is grievously wounded in France, it will have received a blow far more serious than that which it received in the 17th century. And conversely, if upon the whole the influence of the Church should henceforward grow among the French people, it will be difficult for the forces adverse to Catholicism to prevent the continued increase in political power, both of those populations which are ardently and those that are only nominally Catholic, from Ireland to the Desert. See CHURCH AND STATE.

Upon this struggle, much more than upon the other, depends, one may assert, the future fate of Europe. Each is in active progress, and the combination of the two presents by far the most absorbing spectacle of our time.

HILAIRE BELLOC.

2. France.—History B.C. 58 to A.D. 1796. The quadrilateral of Gaul has possessed a geographical and political unity from prehistoric times, and the inhabitants of that quadrilateral have inherited and transmitted certain political, rather than racial, qualities uninterruptedly throughout the historical period. But the first state in which we find them, when the great mass of them were but barbarians, exterior to the civilization of the Mediterranean basin, was, of course, far different from that strictly organized and disciplined unity which two thousand years ago and again to-day were associated with the territory in question.

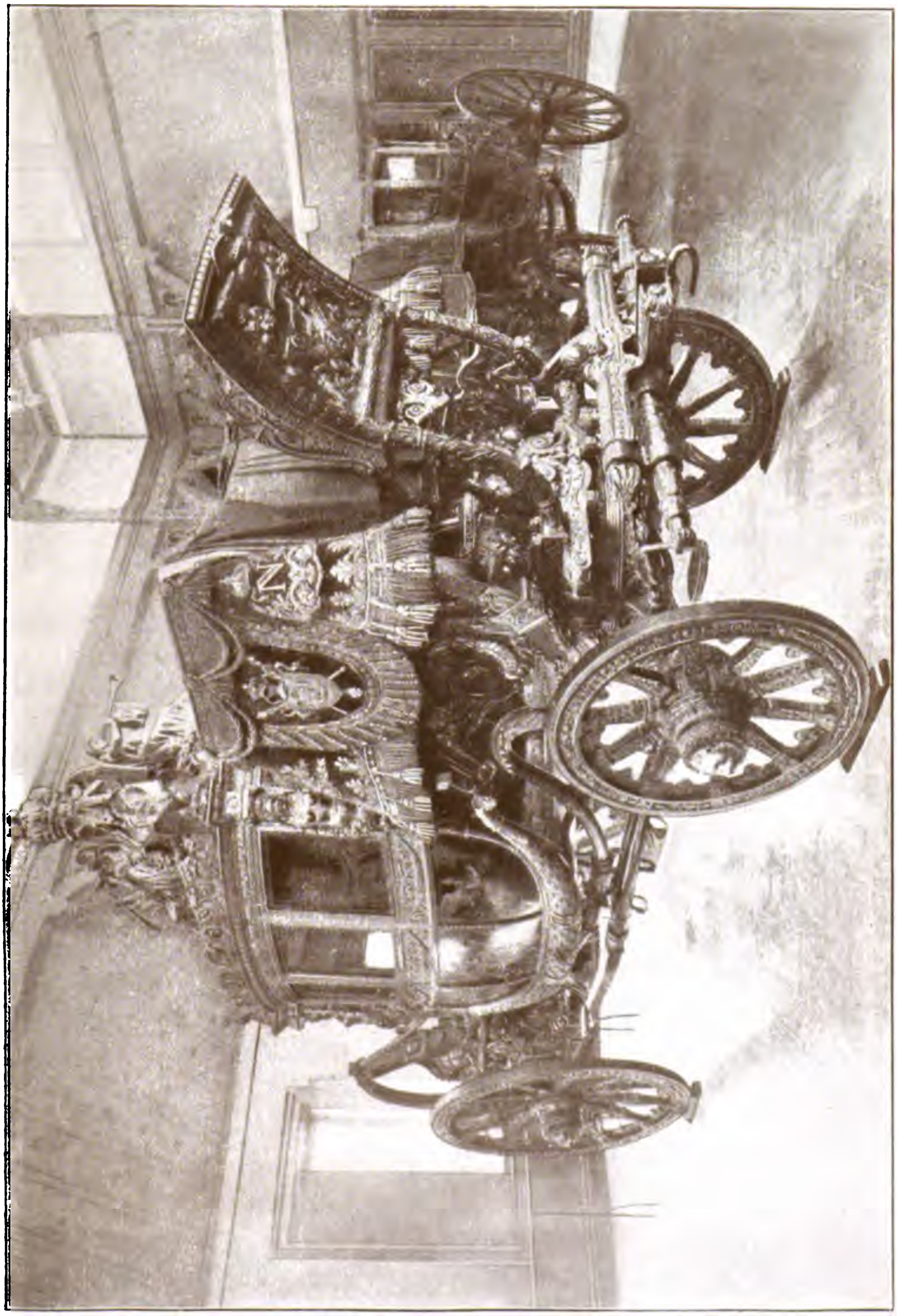
The Gallic tribes were a set of loosely organized clans dependent one upon the other in a sort of semi-feudal organization. It would seem that no one clan ever rose to a complete hegemony over the rest, and again that any small or dwindling clan, long before it permitted itself to be absorbed, would seek defence by recommending itself to some superior neighboring clan. The classic instance of such a dependence is the association of the Parisii who inhabited the neighborhood of Paris, with the large and powerful neighboring clan of Senones, whose capital was Sens on the Yonne higher up the Seine valley. It is curious to note that ecclesiastical arrangements, always the most conservative of institutions, preserved a relic of this relation as late as the early 17th century, for until the See of Paris was raised to an Archbishopric in 1622 the Bishops of Paris were suffragan to the Archbishops of Sens.

The languages spoken by these clans we know little of. We know that the civilized observers of antiquity regarded Gaul as presenting three very clearly marked divisions, which the Romans called (going from East to West), Belgic, Celtic, and Aquitanian Gaul. It has been conjectured that the tribes of the first spoke a variety of Teutonic dialects. It may be asserted without fear of error that those of the second spoke a variety of Celtic. As to the Aquitanian or southwestern portions, some will have it that the Basque language once extended throughout its territory; others that its original language was Celtic like that of the central portion. On all this nothing can be certainly known. As to the origins of this stock we are again in complete ignorance, and it would be idle to linger upon the many conjectures of migrations on an «Aryan race» (the very existence of which is but an hypothesis) or of a «Mediterranean race,» a piece of pedantry converse to and only one degree less futile than the last.

The inhabitants of Gaul have in common from the earliest times a National character and a religion which, though they may have sprung from twenty different remote racial sources, gave them a common aspect. This character, which has been sufficiently dealt with in the introductory essay, may chiefly be defined as military. In the earliest, as in the latest of European history, the Gaul appears marching eastward in quest of military adventure. The religion professed by these people is a more precise matter. It was of a definite and highly organized kind, although its mysteries specifically forbade its propagation by anything but oral tradition. It had for its organs a hierarchy of priests known as druids, and professed, as Gaul has always professed in a manner which seems a necessity to her people, specific dogmas the adherence to which was guaranteed by penalty and the expression of which was exclusively confined to the priestly caste. Among these dogmas the immortality of the soul, the necessity for sacrifice and, we may presume, a universal God, were prominent. A sacrament of bread and wine distinguished this cult and a ritual holiness attached to certain objects and shrines, as the mistletoe among vegetables, and the Grotto of Chartres among places.

The reader must here note the surprising continuity of French institutions, a continuity the like of which is not to be discovered in any other part of the Western world. Indeed it would seem as though the prodigious revolutions in philosophy which in ancient times made Gaul Christian and in modern times have moved her to a great though perilous experiment in democracy, did little but re-color the substantial framework of the nation, and that under

FRANCE.



THE CARRIAGE USED BY NAPOLEON UPON STATE OCCASIONS,

Now kept at Versailles.

every régime national unity, a priestly caste, affirmed dogma, and the sanctity of special shrines distinguished the nature of this people.

From very early times the shore where the Gallic quadrilateral touches the Mediterranean had been colonized by the merchants of the East, Greek and Semitic; and indeed the aspect of this fringe, its climate and produce, apart from its exceptionally political history, differentiated it from the rest of the country. Again, the Gallic hordes had overflowed the Alps and largely occupied the valley of the Po. Again, there were presumably spots (as the Plain of Alsace) where the quadrilateral was intercepted by invaders of another stock. But as we have seen in the preliminary essay, the quadrilateral of Gaul is the permanent habitation of the population with the history of which these notes deal, and that population first attains historical importance with the invasion and conquest of Julius Cæsar. This conquest occupied eight years, from 58 to 50 B.C. It was marked by many vicissitudes, the climax of which was the great revolt of Vercingetorix, which was finally crushed at Alesia. Had Cæsar failed in this attempt one can not say that the Roman power would have been diminished or that of the Gauls extended; it was fundamentally never more than a struggle between civilization and barbarism, corresponding to the struggle undertaken later less thoroughly and with less success by Charlemagne against the Germanic tribes.

As it was, the conquest of Gaul affords such a field for the extension of civilization as has never before or since been afforded to its extension in the history of the Western world. For, first, the «Hinterland» thus acquired was in every way suited to the extension of civilizing power, with a perfect climate, a very fertile soil, a numerous and highly intelligent population; secondly, by an accident without which the Roman Empire could never have come into existence, the Gaul was not only suited to the reception of Roman civilization, but avid of it. Within three generations of Cæsar's great experiment, the whole vast territory was Roman, and more thoroughly penetrated by Roman laws, tongue, feelings and manner than any alien territory has been before or since, with the habits of the conqueror.

Indeed there are but two examples in all history of a success of this kind: that of the Spaniards in the New World, and this of the Romans in Gaul. But the Spanish success, remarkable as it is, does not compare with the Romanization of France. It has achieved a less complete civilization; it was effected at too great a distance from the metropolis.

Other military adventures of the sort have either spread a language or veneered a district with a governing class, without fundamentally changing its daily customs. Such was the Hellenic conquest of the Near East and such was the Roman conquest of Northern Africa, in neither of which were the local dialects extinguished or the local religions uprooted. As for the commercial empires, the Carthaginian, the Venetian or the English, it is not in their genius to impose their will upon subject peoples or to transform these into something after their own image; nor have they commonly made the error of attempting a task so uncongenial to their forces.

This Romanization of Gaul, the most complete, and, in a manner, the most miraculous of historical revolutions, endures in its effect plainly to the present day, and upon it more than upon any other one historical phenomenon, the pattern of Western Europe has been based: its bishoprics, its ritual, its law, its philosophy and its social organization. The municipality, with its elected council, European kingship, the legal class, the village with its lord and its prædial serfs—all these proceed from the Romanized town and the Roman agricultural estate, not so much as they appear in their original Italian, but rather as they appear in their later Gallic form.

Some 200 years after the Roman pacification was complete, the preaching of the Christian religion in Gaul began to achieve its remarkable success. Legend, and even to some extent recorded history, shows us the leaven of this new philosophy at work much earlier: thus the famous martyrdom at Lyons took place as early as the middle of the 2d century, and the saints who there suffered were, through Irenæus their priest, in touch with the Apostolic period, for Irenæus was the disciple of Polycarp, and Polycarp of St. John. But it was from the middle of the 3d to the middle of the 4th century that the true revolution in Gallic thought as distinguished from these sporadic origins was effected. And from the middle of the 4th century Gaul becomes, as it has since remained, the chief scene of the struggle between the Faith and its opponents.

The Monastic Institution, Eastern in origin, was then established by the efforts of St. Martin in the West, to produce, after centuries, the university upon one hand and upon the other the representative system. Again, it was then in the middle of the 4th century that the municipalities identical with the sees of Bishops begin to take on a social importance which has made them ever since pivots upon which French development has turned. And it is significant that about the same time the old tribal names of districts reappear, attached to these municipalities. By far the greater part of French towns to-day bear, not their Roman but their second tribal name.

Coincident with the conversion of Gaul and its organization as a complex and highly efficient clerical hierarchy (which, beginning in the 4th century, became within a hundred years the framework of the whole community and the only structure capable of outlasting the dissolution of the Roman world) came the phenomenon loosely and accurately called «the invasion of the Barbarians.»

There was in fact but one true invasion, and that, to the honor of Europe, was utterly defeated. It was the Mongolian invasion under Attila. Even this was provoked by the use of Mongolian soldiers in the Roman armies. He penetrated with his enormous host to within sight of the walls of Orleans, fell back to the great dusty plains north and east of Chalons,—probably much where the camp now stands. He had with him and was joined by every element of disorder and of chaos: German tribes, and, we may presume, the fugitive, the criminal, and the broken men of that declining period. Opposed to them were all the forces of order and they were victorious. But it was the last organized effort of Rome, and within fifty years a local chieftain was to assume power in Northern Gaul without so much as assuming the titles of Roman officialdom.

The wealthier and the more self-conscious the Roman Empire grew, the more defined its social opportunities, the more ancient and fixed its customs and the more beneficent the religion which its civilization had to offer, the more did it attract the perpetual infiltration of Barbarians from beyond the pale. The process may be compared to the increase of potential which is created by the storing up of a head of water, or any other contrast of positive with negative in physical forces. With every succeeding generation there was less and less temptation or need for the Roman to seek adventure outside the Roman pale. The towns were growing in magnitude, the Roman order had existed so long and with such splendid success as to be apparently eternal. Conversely, there was not a Barbarian within a month's march of the border who was not by an irrestible gravitation drawn towards the enjoyment of such privileges. Some small proportion of the more abject savages were attracted by the mere opportunity of loot. These were easily defeated, though the watch against them was a constant care and harassment. They included the few pirates of the North Sea and the cannibal inhabitants of Scotland. The vast majority of the Barbarians were not of this kind. They were men thoroughly acquainted with the advantages of Roman citizenship, men many of whom (in the case of some groups the majority of whom) had served in the Roman armies and who desired the privilege of being Roman rather than the fruits of destroying the only civilization they could conceive. Moreover, the total number was small, and especially small were the numbers of those who achieved political success. First of these in the history of Gaul come the Salian tribe of whose confederation was that limited and fairly definite race which still inhabits the district immediately to the north and west of the Waloon belt of French and Belgian Flanders. The social and even the military organization of Northern Gaul was in dissolution, when, in 481 a lad whom history calls Clovis and whose actual name may have been spelled in any one of twenty barbaric fashions, inherited the leadership of this little clan. Five years later as a boy of 20 he led them across the border, defeated another body of Barbarians, organized as Roman soldiery, and through the organization of the Church,—notably of the great See of Reims, was permitted to occupy executive rank. It must not be imagined that this, more than any other of the numerous small incursions of the time, violently struck the imagination of contemporaries, still less that it affected the general life of the people. Writs were issued, taxes collected, civil and religious ceremonies performed in the same way, whether the man nominally at the head of the Executive in a province or a district happened to have been born within or without the Roman pale. For quite two centuries this distinction had been of little importance. The new features accompanying the end of the 5th and beginning of the 6th centuries, were merely, first, the advent of a certain though small number of independent warriors who could not be fitted into any known part of the Roman organization (and who were not technically legionaries nor technically Roman officials), and secondly, the break down of the provincial system. City, in the lack of a central power, stood apart from city, each looking to its own affairs. And any petty chieftain, such as Clovis was, would claim to gather taxes, issue writs, enjoy the luxury of the palace, not as the governor of one definite traditional district, but of just so many municipalites as he had troops under him to occupy. It goes without saying that these newcomers at once accepted the religion of the civilization they found, as they did every other of its habits. There was however, one feature, which seems to us of supreme importance, and which the Roman civilization of that date seems to have regarded with indifference: this was the feature of popular language. Semitic dialects lingered unmolested in Northern Africa at this time. And it was a matter of regret to no one or even of curiosity to the learned, whether such a man as Clovis or Theodoric could or could not express himself in Latin. Latin was the only possible tongue for the work of government, for the law courts and for literature. A thousand dialects, Celtic in Britain, Iberian in the Pyrenees, Teutonic in the Rhine Valley, Punic in Africa, which diversified popular speech, played no greater part in the life of the time than private tastes in reading or in cooking do today. Yet the existence of such dialects has warped and distorted the history, especially of Gaul, in that many historians of imperfect information, reading every sentiment of their own time into the past, have seen in language the test of a society, and as we shall discover in a moment, have even made of such a figure as Charlemagne a sort of modern German nobleman.

In this Gaul then, which remained as purely Roman as before, with no perceptible admixture of new blood, and with no change in the methods of government save a gradual weakening and coarsening of them, Clovis established himself in executive power over the municipalities of the North and East; having, that is, the right to issue writs in his name, to gather the dwindling taxes, and to reserve for his part the luxuries and the honors traditionally incident to the position of a great Roman official. For more than a century, till the advent in 628 of Dagobert, the great-great-grandson of Clovis, this local executive power is as vague and changeable as can be. It depends upon personal prowess in battle. Now the petty kinglet in the North stretching his nominal power almost to the Pyrenees; now the whole territority is divided among brothers; now there is an alliance with other Teutonic chieftains of the Burgundian or Visigoths in other parts of the territory; now for a moment the whole is united again in one hand. Save as concerned landmarks, the lives of these Kings are unimportant. The social fact underlying the whole business is the dissolution of one portion of the Roman organization and the survival of another. The portion which dissolved and whose instruments of power became first nominal, then merely legendary, was the central authority and the army upon which it had reposed. The portion which survived and which even increased in strength as the darkness of the time deepened, was the municipality, and above all the clerical organization based upon the municipality.

Meanwhile, like any great body that has gone through a sharp readjustment of conditions, the western districts of the Roman Empire by the 7th century began to organize a new and a debased but yet a stable life. The conditions were these: Britain had been for more than a hundred years quite cut off from the Roman world and the Eastern half of it nearly ruined by pirates. Africa had been overrun by every sort of wastrel, escaped slaves, nomads of the desert, starving peasants, and criminals, gathered round a small nucleus of wandering Teutonic Barbarians called Vandals. It had been temporarily regained by the Imperial power, but was never again the orderly and civilized province which it had been for 700 years, and was destined in the next century to be permanently effaced by the Arab invasion. In Spain and in Gaul the Roman municipality endured, and little bands of Teutonic raiders had established their chieftains as nominal heads of the Executive power. Men had settled down to this conception of the world as to the obliteration of the old central authority; they were long used to seeing upon their parchments the curious names of Germanic origin which had replaced those of the Emperors. Letters and arts had so declined that the past had become a fixed standard of excellence, the attainment of which was despaired, when the ruins of the old Roman order began to group themselves again into something of a stable (though of a coarsened and much lowered) civilization which is generally called that of the Dark Ages. And by an historic accident this civilization was nowhere fully preserved save in Gaul.

This accident was the successful Mohammedan invasion of Spain, a catastrophe which left Gaul the only intact Christian unit, and therefore the only seed plot in which the tradition of civilization could hold its own and be preserved.

Britain was hardly yet re-christianized, and civilization had but just begun to strike its new roots. Theodore had but just organized the Church in that island, and it was still a mass of little warring districts, when Taric landed upon the shore which still retains his name under the Rock of Gibraltar, in 711. In two years the Mohammedans were at the foot of the Pyrenees, and the whole intervening plateau with its Roman municipalities, its organized hierarchy, its European traditions of 900 years, was subject to the Asiatic.

The consequences of this disaster were enormous. The Western Mediterranean, the common highway by which Roman influence has welded all Western Christianity together, was henceforward Mohammedan. Its islands were open to perpetual invasion, many of them to regular occupation (the Balearics were not recovered by Christendom for over 500 years!); every seaport which had escaped actual conquest was open to perpetual insult; Italy, already a mass of independent localities, now lay as to its southern half, open to influences the most antagonistic to those of Rome; Rome itself might henceforward almost be called a frontier town; the balance of the great provincial system was destroyed, and a general observer of history who should not be acquainted with what was to follow might imagine that after this blow Christian civilization and all the traditions of Rome and the West could not but perish. As a fact, by a process with which this paper has not to deal, the indomitable energy of the Spaniard reconquered the Iberian Province and slowly re-established the civilization which we now enjoy. The debt we owe to the crusading spirit of Spain is not calculable; but for it there would not to-day be what we call Europe; its learning and its religion would have perished. As it was, for many hundred years, with Britain hardly civilized, Spain lost and Italy distracted, Gaul remained to the close of the Dark Ages the one intact remnant of Europe.

Meanwhile there had been proceeding in Gaul itself a transformation in the nature of political authority which was destined to have very wide-reaching effects. The spirit of the municipalities, organized and aided by the Bishops, had restored a conception of National unity, and the Frankish Kings were at the head of that unity, the nominal centres from which a political power, debased but still Roman, proceeded. These kings were manifestly unequal even to the moderate task of governing the decline of civilization. The great landowners who formed by this time an intimate mixture of Roman and German families, grew more and more important as communications became more difficult. Chief among these land-owning families was one which had acquired an hereditary position of predominance in the palace. This family had originated in a Roman noble of the territory of Narbonne, nearly 300 years before, but as was the case with nearly every other great Roman territorial family of Gaul, there had been continual intermarriage with families of German-stock, and prior to the Mohammedan invasion of Spain this family is found having its principal seat in that one of its many estates which lay in the eastern part of Gaul in the boundary of German-speaking territory. It was therefore, in the language of the time, an Austrasian family, for the French monarchy was roughly divided into Neustrian or Western, and Austrasian or Eastern, though these divisions did not correspond to anything in race or language, but were convenient categories in which to reckon the topography of the scattered estates. This family was already virtually ruling in the place of the king when the great head of it, Charles, led the combined Gallic forces against the Mohammedan invaders who had passed the Pyrenees in 732. This horde of Asiatics, crossing various parts of the chain of mountains but proceeding mainly by the middle road of the Imus Pyrenæus, sacked the cities of southern Gaul, were turned northward by the resistance of Toulouse, passed through Poitiers and were marching upon Tours and the North when Charles Martel (Charles the Hammer) met them on the plateau of Dissay about half-way between the two towns. Their force was completely destroyed and Europe was saved. The son of Charles, Pepin, was still more patently the head of the State, though for several years he refused to accept the crown; and it is under him that Gaul appears as the protector of the Papacy, an institution which French military power was to support continuously for the next five hundred years. It was not only at the call of the Gallic municipalities and the hierarchy, but also by the direct sanction of the Pope that Pepin in 752 accepted the crown. He died in 768, leaving, as was so constantly the barbaric custom of the time, political authority divided, between his two sons Charles and Carloman; the latter died in 771, and Charles, now 29 years old, became the sole ruler of the great territory which was now the only unbroken piece of the ancient empire, and the only one subject to any sort of central authority; around it upon all sides, in Britain, in the German Marches, in the southern valleys of the Pyrenees and of the Asturias, in Northern and Central Italy, was a confused mass of petty lordships, and beyond that again the external belt of enemies of the Christian faith and Christian civilization, the savages of Scandinavia and of Central Germany, the Mohammedan power of the South. The great Charles, therefore, whose title in history is Charlemagne, stood upon the defensive, as it were, throughout his long and glorious life, holding an island of Christendom against the pressure of these external forces. His defence was successful, and that long respite permitted Christendom to accumulate just so much strength as was sufficient in the next century to repel, though hardly to repel, the final assault of the anti-Christian power.

The reign of Charlemagne extends over 46 years, 43 of which he enjoyed as sole sovereign after the death of his brother, and during the last 14 of which he had mounted to that miraculous position which earned him the title of Emperor of the West and has caused him to fill not only the legends of Europe, but also, as with an original light, all the beginnings of modern European history. His period, therefore, is one of the many of which we can say that the uninterrupted presence of one man at the head of a State for a long period gives that period a peculiar unity and significance. This is often true when the man is merely a symbol; it is particularly true in a semi-barbaric condition of society, when the man happens also to be of military virtue and a successful warrior. That the personal character of Charlemagne determined this wonderful episode in French history, it would be an exaggeration to say, but that personal character made the episode possible; these 40 years and more are full of his individual effort, and they have something personal and epic about them, like the eras which lie behind recorded history at the origin of every civilization.

He was 26 when his father died. Before he was 30 he had determined to extend civilization into the Saxon forests, and he had begun to do so. In his 32d year he crossed the Alps; in his 33d (in 774) he destroyed the power of the Lombards in Italy, and for the second time confirmed, as his father had confirmed, the temporal power of the papacy. The next year he was back again in North Germany, and the next year again in Italy once more; the year after that, for the third time, he was conquering among pagans of Saxony, and this time received at least the oath of their reluctant allegiance. The next year he was off again over the Pyrenees, negotiating with, pressing back, harassed by, but checking, the Mohammedans. The Saxons rose behind him; he hurried North again. In 781 he is yet again in Italy. He was not 40, and these first 14 years of his had been as full of violent and successful war as were the first 14 years of Napoleon. This elegy of rapidity and success, backed by a sort of renaissance of the Gallic spirit, so powerfully struck the imagination of the time as to make him, even in that period of rapid decay or transformation, the necessary leader of a united Christendom. It is from these swarming campaigns that the first new songs, or rather epics, of our modern Christian civilization drew their inspiration, notably from that check or defeat of his rear guard in the pass of the Imus Pyrænæus as he was retreating from Spain, a disaster in which his nephew Roland died, and from whose memory sprang the noblest of Christian poems, the 'Song of Roland.' On Christmas Day of the year 800 the culmination of these campaigns saw him crowned in Rome by the Pope, Emperor of the West. The old title thus revived was but a symbolic name. He himself could exercise central and imperial power in a manner only distantly resembling the old Roman model upon which his title was based; and in the century that succeeded him that title became little more than a name. But it can be said with regard to the title itself and to his individual occupation of it, that it revived just before the memory of such an institution would have decayed, the tradition of an Europe united under a military head. That tradition has never wholly disappeared, and, fantastic as such a prophecy may seem to-day, the future may very possibly see it revived.

The remaining years of his life, though all around the frontiers of his empire the last effort of anti-Christian forces was ready to be made, were full of a sort of tranquillity and splendor which the insufficient knowledge of the time might vaguely compare to the ancient authority of Rome. He died 28 Jan. 814, at the beginning of his 72d year, and was buried exactly upon the confines of the two languages which he spoke, upon the limits of the civilization which he had preserved, in the old Roman watering-place of Aquæ, called since his time Aix-la-Chapelle, his favorite residence. There, in a church long since rebuilt, under the influence of mediæval French architecture, he still lies, surrounded by modern architecture more appalling than most that is to be discovered even in the rapid industrial development of North Germany in our time.

The experiment to which Charlemagne had devoted such energy, and in which he had achieved such success, turned out both at the time and in the judgment of long future generations far more than he or his coadjutors had intended. The vigorous and united symbol of

Christian and civilized Government which his reign had afforded served as a bridge. It prevented Christendom from too much forgetting (though it necessarily largely forgot and blurred) its Roman origins, and it afforded also a halting place to which the Trials and the new youth of Europe could look back in succeeding centuries. The reign of Charlemagne is like a holiday, or like a light in the night. It breaks the continuity of the dark ages, and largely through his intellectual vigor enables us to understand the transformation of Europe from the antique to the modern.

In spite of these qualities in the time, the vital forces of Gallic civilization were still declining. Men built less well and thought less well from year to year, and when the omnipotent Chief of this military episode had died in 814, there broke upon what was left of civilization the heaviest storm it had hitherto endured. In that storm Europe, and therefore its surviving centre in Gaul, was nearly overwhelmed.

The pagan tribes of Scandinavia, a fresh horde of Mongols, a renewed splendor in Islam, all fought together against the Christian name. It was a far stricter ordeal than were the barbarian invasions of the 5th century; indeed, there was but little relation between these infiltrations of that period and the savage attack of this. The numbers were far larger, the opposing forces of civilization were far weaker, knowledge and discipline by which alone civilized men can resist barbarians were at their lowest ebb.

The issue had already been joined in the British Islands by the beginning of what are known as the «Danish Invasions.» Some 30 years after the death of Charlemagne it menaced what was left of the Christian continent, and with the close of the 9th century it came to a climax. In that whirlwind two things of vast importance to the future of Europe occurred. The first was the military success of a Christendom absolutely united in religion; the non-Christian was beaten off by men of one faith and one ritual and of one immutable manner of thinking. The second was that so much was forgotten and so many traditions lost in the struggle as to necessitate the growth of a new society. It is in this close of the 9th century that the old owners of the land, mainly Roman or Gallic in ancestry, become territorial lords. It is in this period of darkness and upheaval that the long process of independence is at last achieved, and that the village communities with their chiefs finally adopt those groupings for self-defense which are later called the Feudal System, and it is in this period that the subconscious national groups of Europe take on conscious form.

Two points of Western Europe determine the struggle in favor of our tradition and of Europe. These are the southwest of England, Somersetshire and Berkshire, in which Alfred outlasted the savage invader and finally defeated him; and Paris, where, just before, the local forces had beaten back the same enemies in a memorable siege in 885.

The second alone concerns these lines.

To understand the city of Paris is essential to anyone who would understand the history of France. The town has played for a thousand years the same part in the Government of that country that the English governing class or plutocracy have played in Britain since the Reformation. Thence have orders proceeded; thither has intelligence flowed, and there has been fixed that specialized organ of administration, round which all national development gathers, and which, though it has many names in many polities, is a necessary nucleus to every great nation.

Paris had risen to its great position through the waterways of northern France. In the breakdown of Roman order the disuse of the roads and the collapse of the posting system had increased the importance of the rivers in a nexus of which the city found itself, and from the last Roman emperors it had maintained a sort of special place, not as a capital (for there was no such thing), but as a chief town—the town of Clovis and of the early kings, the town in which the early Carlovingians came to die and in whose shrine they were buried.

The local chief—who stood the siege of 885—was by name Odo. Of the ancestry of his father Robert we are not over certain, but from that father and his descendants sprang that line of men who symbolized the rejuvenescence of Gaul when the struggle was over, and in whom centered that which was at once the symbol and the organ of the new nation: the Monarchy.

Robert the Second, the brother of Odo, was, like Odo, elected to a rough kingship, in the contempt which all felt for the decaying idea of the Carlovingian Empire, and the grandson of this second Robert, Hugh, was formally crowned at Noyon, and the separation of French Government from the mass of Europe was complete.

From that moment, for exactly 800 years, to the assembly of the nobles under Louis XVI., the monarchy, retained in one house, perpetually increasing its power, is synonymous with and develops the consciousness of the nation. This date, 987, stands as the second landmark in the history of France and our first business before entering the story of that great development is to consider how Gaul looked when the first of its nominal Chiefs was crowned.

Beneath the various episodes which have been described beneath the great names of Clovis, of Dagobert, of Charles Martel, of Pepin, of Charlemagne, of the Robertian House of Paris, whose principal descendant, Hugh, we have just seen crowned, a slow but complete molecular change in society had taken place. The old Roman order had not only decayed, it had also been internally transformed in the 500 years which intervene between the invasion of Clovis and the crowning of the first French King. The slaves of the old Roman landed estates, though still legally slaves, were no longer bought and sold; they had become Christian freemen; the old Roman landed estate had become Christian village and parish; in the breakdown of communications and of learning, agriculture had become, as it were, the sole industry of men. This agriculture had grown to be neither an individual nor a servile, nor what we should call to-day a capitalistic industry, but a co-operative one. The old Roman landlord was now no longer the possessor of the whole territory of a village; only a portion was reserved to himself, and the village population beneath him had grown by centuries of custom and of cohesion to security of tenure and to fixed and customary payments of labor in the place of that surrender of all their energies which their former servile condition had implied. The vast mass of the population, therefore, lived as perpetual holders of land at a fixed and customary due of labor or what-not paid to a local superior; they cultivated the fields together, but apportioned the result in proportion to their respective holdings. The lord with his much larger holding, as he was the richest among them, was also their protector, and, in a modified way, controlled by tradition and by the assessment of his own tenants, their judge. The village so organized was a microcosm of the whole of society. For centuries the noble class, the men descended from the old Gallo-Roman owners of land and of slaves, had tended more and more to regard themselves also as tenants whose absolute ownership, though absolute, was part of a social system involving superiority, social and executive, in some greater man among their number. They had coalesced in groups, usually under the largest landowner of the district, during the pressure of the Barbarian wars; the man owning but one or two villages would «recommend himself» to some local man owning ten or more, and he in turn to some very wealthy personage of the countryside who had accumulated by marriage or inheritance the dues and the lord's portion of, let us say, a hundred villages. And long before the Carlovingian line was extinguished or the new Capetian line was acknowledged, society had become a complicated territorial system with the tenants of the village dependent upon but secure under the village lord, and with the village lords forming indeed one noble class, but arranged in a hierarchy of dependence from the small man, who was but lord of one village, through the big local man of the countryside, up to the overlord of a whole province. What determined the size of these provinces it would be impossible to say; some, like Normandy, were but an old Roman division which had maintained its boundaries; others, like the March, in the centre of France, were vague to a degree, built up of intricate local traditions and customs, and in dispute with their neighbors for all except the very centre of their dominion. Some were quite small, little more or less than a bishopric in extent; others were virtually independent kingdoms, like Brittany; but of all it was true that they formed the true sub-units in the general national unity. The particular house which had been given the symbolical and nominal headship of the nation under the title of King, were the dukes or local overlords of the Isle de France, a territory of which Paris is the centre (they were the lords of Paris, as we have seen), and which extends, roughly speaking, for three days' march round the city. To this house, once the head of it was crowned, the other great houses swore fealty, thus completing the hierarchic system which in its complete later and legal form was called *feudal.* It must not be imagined that the system was as yet symmetrical, even in theory. Not all the efforts of the lawyers during the next three centuries, the 11th, 12th, and 13th, while it was still quite vigorous, could make a thing of such obscure and natural origin symmetrical. But the general arrangement of society, the small farmer secure on his holding under his lord, that lord under a wealthier man of the same countryside, he again under a Duke or Count of the whole province, and he again swearing fealty to the King, who was the symbol of the National unity, is the great social fact we must keep in view if we are to appreciate the development of modern France out of the Dark into the Middle Ages.

This family, the overlords of the Parisian centre who had been crowned King, for a century did nothing but accumulate in their hands more and more manors, and cultivate by an instinct those remaining forces of civilization, the municipalities and the Church, which everywhere unconsciously strove to reproduce the old Roman order which had so nearly disappeared in the Dark Ages. To Hugh, in 996, succeeded his son Robert; to Robert again in 1031, his son Henry; to Henry, in 1060, his son Philip, and to Philip, at the opening of the 12th century, succeeded, first in actual and next in theoretical kingship as well, his son Louis, «the Fighter,» with whom a new expansion of the power of the Crown begins.

Thus four men, each in direct succession, each crowned coadjutor during his father's lifetime, each arriving at the throne in the vigor of his manhood, for well over a hundred years secured the continuity of the new experiment. None save Hugh was remarkable for domination; Robert rather for piety, Henry for a quiet tenacity, Philip for debauch; but all, to some extent in spite of themselves, were accumulators of territorial wealth and influence, and every social influence of the new time worked upon their side. That time, the 11th century, was one in which the energies of Christendom suddenly awoke. No new forms were discovered for it, the old architecture continued, the old customs were observed; but everything from the Rhine to the Atlantic, and from the Tagus to the Channel, was boiling with a vigorous and novel life destined to bring forth the Middle Ages. The advance from the Pyrenees against the Mohammedan begins in the generation just after Hugh Capet's crowning, and the entry of the Christians into Toledo is effected within that hundred years. It is the time when the curious phenomenon of cross-breeding, the vigorous, unique but ephemeral «Norman» race comes into being, spreads civilization through England, conquers, unites, administers, and forever attaches to Europe and separates from Oriental influence the South of Italy and Sicily. It is the time when consonant to the necessities of such new vigors and such new light, the Christian Church redefines its unity, cleanses and organizes all its machinery, and imposes a working discipline under the advice and, at last, the papacy, of Gregory VII.

Many new phenomena advance in parallel, all connected with the general advance of the time, but each following its own path. Architecture does not change, but is everywhere pursued with magnitude and vigor; men are still ignorant of the world outside the Western Christian unity, but although definite learning has not yet been organized, curiosity is wide-awake; and the municipalities which had remained so long anomalies in the agricultural system, osseous relics, as it were, of the old Roman structure, begin again to live everywhere by an independent life. The new roads are not yet built; men still march along the old decayed Roman highways, or make use of the river systems or of the sea; land is not yet bought and sold;

no universities are yet in existence; no Gothic arch has yet been built; vernacular speech is but a tentative beginning, unknown in England, very local and disparate in France, in the Spanish kingdoms and in Northern Italy; no representative system has yet met (save among the clergy), but all these things, the representative system, the Gothic architecture, the universities, vernacular literature, are in seed and are germinating during the 11th century. The outcome of these various energies, their climax, and at the same time the event by which they were to be made fruitful, was the Crusade. The long example of the fighting in Spain, coupled with the unrest of the multitude and with the critical condition of the Eastern pilgrimage, had kindled a flame, and there poured out in successive hordes, mainly from Gallic territory, a host on the march for Jerusalem, the latter and organized portion of which must have been as numerous as that with which Napoleon invaded Russia, the unorganized forerunners of which may have numbered a million souls. Established by the papal sermon of Urban II. in 1095, equipped in the next year in the Summer, they trailed out in a prodigious raid of over 2,000 miles, and three years later, 15 July 1099, the remnant that had survived or persevered stormed Jerusalem and established for close upon a century the curious French experiment of a Christian outpost against Asia, established in French castles, defended (in such a climate!) by French armor mounted upon French horses, in the isolated belt of Palestine and of the Levantine coast.

The effect of that march was overwhelming; the sudden expansion of experience, the awakening of the mind, which accompanied it, produced the Middle Ages. And when from 1100 to 1115 such lords as had not established themselves in the East returned to Gaul, they discovered the monarchy renewed, and the National movement in full strength under the vigorous personality of Louis, who, though the first of that name in the Capetian line, called himself, in memory of the Carlovingians and of the Merovingians, «the Sixth.» The towns, the hierarchy, the populace, everywhere seconded this re-founder of the monarchy, and when he died, in 1137, his son Louis succeeded, heir to an executive power which was no longer founded upon territorial possession nor merely the nominal feudal bond between the great overlords, but possessed a military power of innumerable garrisoned fortresses, of a legal corporation actively allied to the Crown, and of market-towns and great cities which throughout the territory of Gaul were prepared increasingly to insist with every new generation upon the power of the King of Paris in whom they saw the living figure of the nation.

Now, at the end of the first third of the 12th century, France and Europe were fully awake. A whole generation had grown up accustomed to territorial expansion (it was a generation since the Christians had entered Toledo and a generation since the first Christian king of Hungary had died; a generation since civilization had re-entered England and a generation since the first Crusade had brought the West into touch again with the East and had begun again to teach the Christians of the Mediterranean the uses of the sea. It was a generation since the papacy had become a free and self-organized thing, elected from within the hierarchy, and a generation since unity of discipline had been established throughout the West by the powerful will of Gregory VII).

The first effect of the new life was the awakening of intellectual discussion, and of this discussion France, and Paris in particular, were the seat. It turned upon the fundamental problem of all philosophy, the reality of ideas. It had for protagonist Saint Bernard upon the orthodox side, and, in a manner which pretended to compromise but which was really opposing, the brilliant genius of Abelard upon the side that would have led to schisms and perhaps at last to the negation of God. That debate consciously or unconsciously is still in progress; the affections and sympathies of the two parties are to-day much the same. Out of it arose as its first fruit the University. Paris began to found those colleges and to group them into that united organism which soon became the great European model for the collegiate university. Parallel with the growth of a new curiosity came in the same place and from the same people the marvelous symbol of Gothic architecture. Suger, the abbot of St. Denis, the friend and counsellor of King Louis VI., and in a sense the guardian of his son, was the first to light the flame. The south tower of his façade is the first bit of true Gothic in Europe. The same masons who had built it in their youth might have lived in their late manhood to see the beginning of Notre Dame; and with Notre Dame, the first great Gothic building of Northwestern Europe, the style was fixed.

All this movement and advance corresponded to the reign of Louis VII., the son of Louis VI., and to that middle period of the preceding century which is marked by «the Second Crusade,» and in which it was increasingly felt that the French hold on Palestine was doubtful and precarious. This reign was of great length; it stretched from 1137 to 1180; its central episode, the Crusade, was undertaken upon the news of the fall of the frontier fortress of Edessa; it occupied the two years from 1147 to 1149, consisted in a futile attempt to take Damascus, and did little other than weaken the prestige of the Christian name in the East.

As has already been pointed out, not only the Crusades but the new movement and expansion of Europe, the reflowering of civilization had necessarily helped the growth of the power of the Crown; that power, apart from the ceaseless support of the clergy, the lawyers and the towns, reposed upon two territorial bases, the King's political position as superior over the great provincial lords, and the King's economic position as private lord over a number of manors and countrysides. In the first of these he could grow only by the growth of an idea, but in the second he could grow in a material and actual manner. Already the crusading movement had led in Louis VI.'s time to the crown's becoming direct lord of the province of Berri, and thus obtaining direct possession of a district south of the Loire, and in a vast number of minor cases, only a certain proportion of which even are recorded, the commercial and military movement of the time was letting isolated manors and lordships fall by escheat, by confiscation, by disputed possession, and in general by the active presence and effort of the lawyers, into the King's hands; and with every new step in the power of the kingship, the consciousness and unity of the nation increased also.

An accident coming immediately after the second Crusade, an accident which for the moment seemed to check the rise of the Capetian house, proved within half a century the main factor of its definite establishment. The heiress of the crown of England, Matilda, the granddaughter of the Conqueror, and widow of the German Emperor, had married the lord of the great province of Anjou. Her son, Henry, landed as a boy in defense of his mother's rights against Stephen of Boulogne who had contested the English succession and was acknowledged heir. In 1154, therefore, by various relationships Brittany, Anjou, and other lordships, were in the hands of a young and vigorous soldier who also became King of England and Duke of Normandy. Or, to put it as the French lawyers saw it, the Dukes of Brittany and Normandy, the Count of Anjou, etc., were all merged in one person, and that person was the powerful King of England. Nor was this all: The vast territories of Aquitaine, a feudal overlordship which, roughly speaking, comprised all the southwest of France, had ended in the hands of an heiress, Eleanor; the male succession had failed. Eleanor had first been married to Louis VII. of France, and had accompanied him on his crusade; her desperate character had led to a divorce, and immediately upon its pronouncement at Rome, Aquitaine, after its momentary union with the crown of Paris, fell into the hands of this same young claimant to the crown of England, for the divorced woman married him. The position, therefore, on Henry II.'s accession was this: that the feudal lordships of all Gallic territory west of a line drawn roughly from the centre of the Pyrenees to the neighborhood of the mouth of the Somme were in the hands of one man, and that man the King of England. In pure theory the French crown stood as it had stood before: it was still overlord of the whole, and Henry of England had to do homage separately for each province; but in practice three things gravely modified this theory. First, the united control of territories which in the aggregate formed two-thirds of French territory; secondly, the fact that these two-thirds included the maritime and commercial portion of every single great French river (Rouen, Nantes, Bordeaux, were all within Henry's boundaries) and thirdly, the complication by which these maritime provinces were in the hands of an island king. There is little doubt that if the relationship had endured for a couple of generations, its theoretical side would have weakened to such a degree that the Capetian power would have dwindled to a shadow and very soon a Plantagenet would have ruled in Paris. It did not endure. When Louis VII. died in 1180 he was succeeded by his son Philip Augustus, a man in whom the energies and the clear judgment of this new birth of civilization seemed to centre. It is evident that from the beginning of his reign Philip Augustus's great object was to destroy the overwhelming position of the House of Anjou. Fissures were opened in the great fabric by the perpetual revolts of Henry's sons under the impulse of their mother, a curse to her second, as she had been to her first husband. The fall of Jerusalem in 1187 led to a third crusade. The old king Henry died; his son, Richard I. of England, still nominally the Lord of all these territories, went to the rescue of the Holy Land as did Philip Augustus himself. Richard was imprisoned on his return; the French king intrigued to prolong that imprisonment, and though he failed, fortune was on his side when Richard I. died at the siege of a castle in 1199, leaving England and all the French lordships to his brother John. The opportunity afforded by John's character was exceptional; his premature regency, his license, the envy aroused by his cultivation and his prowess, united against him the feudal aristocracy of England. The claims of Arthur, his nephew, the heir to Brittany, and in strict right his senior in succession to all the territories, coupled with complaints due to his marriage with the betrothed of the Count of la Marche, and the rising of Poitou, gave Philip Augustus a pretext for summoning John as feudal inferior to clear himself before a court of his peers. He failed to do so; his land was declared forfeit; the claims of Arthur were pressed. This was in 1202. In the war that followed young Arthur was captured and shortly afterwards disappeared. John was accused of the murder, and the powerful armies of Philip were supported by the general indignation of Europe. By the end of 1205 only a few towns near the seacoast remained in the hands of the English king. Though the physical conquest of the Angevin territories was thus achieved, the victory was not really ratified till 1214. In that year John, the best diplomatist of his age, rallied against Philip Augustus all the forces which it was possible to bring, moral and material, into the field. The Count of Flanders, against whom Philip Augustus had resolutely set the Roman municipalities of that district, the German Emperor, and the sympathy of the papacy were marshalled in this critical month of July against the French Crown. Philip Augustus won a decisive victory. It was not only a decisive victory for the French Crown at that moment, it was one of the very few battles in which history may be said definitely to have marked the success or failure of a great historical cause, and it affirms for 600 years the power of the French monarchy and for a much longer and indefinite period the unity and existence of the French nation. It had also its reaction upon England, for the aristocratic insurrection against John was emboldened by this defeat of his to press on to the consummation of Magna Charta.

Meanwhile yet another factor had entered into the rapidly growing consolidation of the Capetian hegemony. The Albigensian Crusade had been undertaken and had succeeded.

Contact with the East has invariably produced upon Western Europeans an effect which may be compared with the effect of a spell, and usually of a maleficent spell. Its effects may be clearly observed in those modern nations which have the misfortune to be intimately mixed (especially if their governing class is intimately mixed) with the Asiatic. Oriental customs and vices and Oriental weakening of European health enter in with too much knowledge of the East. The Crusades, now a century old, had cast such a spell over the highly civilized townships of the South of France, and a confused mass of Oriental customs whose origins or nucleus had in the town of Albi overspread the County of Toulouse and its surrounding territory. The danger grew with startling rapidity; the Pope called against it the military power of the overlord, the Northern barons especially answered the call; the fight began in 1208, and the re-establishment of Christian unity and civilization was effected within four years. This campaign, which in the eyes of contemporaries was mainly a campaign for the unity of the health of Christendom, has for these notes the particular importance that it converted what was already a nominal into a real supremacy of the power of Paris over the southern portions of Gaul. The date 1215 may be taken as the term of all this development. England was now pledged to an aristocratic policy which would weaken the growth of a great civilized state. The Lateran Council had affirmed, in its most determined form, the framework of mediæval Catholicism, the Capetian crown had triumphed over all its enemies at Bouvines, the South was definitely in the grip of the monarchy; and on the southern frontiers of Spain the great and successful fight of Navas de Tolosas had extinguished forever the threat of the Mohammedan. Henceforward Islam dwelt only upon sufferance between the extreme boundaries of Andalusia. In Paris, the Louvre, the symbol of the established monarchy was built, and round the city the great new wall, built at civic expense, was the symbol of that new mediæval civilization which was in a way the resurrection of the Roman municipality. The university was chartered and active; the epoch of the 13th century, the climax of the French race and certainly the climax of European development between the Dark Ages and the Renaissance, had come to flower. Philip Augustus died in 1223. The three short years of his son Louis VIII. were mainly distinguished for a triumphant march through the South, and in 1226 the personality who stands most for the 13th century in Europe and in France, that of St. Louis, the grandson of Philip Augustus, was seated upon the throne.

He was but a child, under the tutelage of his mother, Blanche of Castille, but even during the period of her guardianship, which was troubled by civil war, as such minorities invariably were, the power of the Crown was but the more confirmed; and from the time when the King was of age until he undertook in 1248 his first crusade, there was established by example and by vigorous action, so absolute a strength in the monarchy that all the defeats and vicissitudes of the next 200 years were unable to shake it. It had acquired a sanctity that was almost legendary and an actual force which made it coincident with the National life. The crusade of St. Louis was directed against Egypt, for Palestine was now a dependency of Cairo and the recovery of the Holy Land could only be accomplished by the reduction of the Mohammedan power upon the Nile. The five or six years during which the effort lasted were, upon the whole, unsuccessful. St. Louis returned in 1254 with a vastly increased reputation, by far the chief figure in Europe, but there remained of the old French garrisons in the Levant nothing but a few port towns at the mercy of occasional sieges, and doomed to ultimate capture. The 16 years that followed were years of quiet and successful administration, during which the most interesting experiment was that in which St. Louis, after defeating Henry III., the English King in the South, granted him a narrow territory in that region as the price of what was imagined to be a lasting peace. The King, though long past his 50 years, was moved in 1270 to another crusade. The attempt this time was made against Tunis, but at its very inception St. Louis died on the spot that is now marked by his chapel at Carthage. It is possible that the expedition to Tunis was suggested by the position of his brother Charles of Anjou in the south of Italy, for Charles, who 25 years before had married the heiress of Provence (thereby still further increasing the power of the House of Paris) had been called in by the Pope to combat the last efforts of the German Empire in Italy, and held for the moment, but only for the moment, the sovereignty of Sicily and of the Kingdom of Naples. The massacre of the French in Sicily in 1282 put an end to his power, but it did not afford any opportunity for the interference of the Empire with the papacy or with the affairs of the Italian peninsula. With the fall of the last Hohenstauffen, the mixture of the Germans in Italian affairs comes to an end forever and the anarchic welter and ill-organized conception, which had called itself for the last 300 years the Empire, meant nothing more in future but a loose confederation of shifting Teutonic lordships. The Valley of the Rhone, over which a German executive power had nominally existed for so long, though not yet technically subject to the French king, was now virtually within the orbit of which Paris was the centre. The reign of Philip III., son of St. Louis, from 1270 to 1285, contains little of moment. His son Philip the Fair, who came to the throne in this latter year, marks, despite evident signs of internal decay, the summit of the material power of this first unbroken Capetian line. His mother, the heiress of Navarre, brought to the Crown that kingdom or province. His long struggle with the papacy ended in the capture of that institution, the election at Lyons in 1305 of Clement V., and the presence at Avignon of French popes for 70 years. He had the strength to destroy the gross and highly dangerous power of the Templars, a military order which had grown to be an immensely wealthy secret society upon which the just execration of the European populace fell from every side. When he died in 1314 it seemed as though no further advance could be made in the strength of the French sovereigns. Yet it is from that date, or shortly after, that the chief peril of the Nation and of the House itself must be counted. For Philip the Fair left three sons; and, by a catastrophe hitherto unknown in all the three centuries which had seen the rise of this great family, a direct male heir to the succession failed. These three sons, Louis X., Philip V., and Charles IV., each enjoyed a brief reign, and each failed to leave a son who should succeed him. The whole course of the three reigns covers no more than 12 years, and the only chance of a direct succession lay in a man-child, John, who died within a week of his birth. Charles IV. did indeed leave a daughter, but the tradition which had strengthened for so long and whose example had been so glorious, by which a male heir alone could succeed, led through a curious legendary fiction or memory, embodied at last in definite constitutional terms and called by the name of «the Salic Law,» to the rule that only a man should succeed to the throne. The nearest male heir, therefore, if this baby daughter of Charles IV. were to be set aside, was the first cousin of Charles IV., Philip of Valois. Philip the Fair's brother Charles had been granted the title and position of Valois. It was his son who now laid claim to and immediately mounted the throne in the year 1328, 14 years after the death of his uncle. The Capetian House had proceeded without check from father to son in the virtual control of the town of Paris and the Duchy of France for more than 400 years. For 340 it had held that position with increasing magnificence, the son regularly succeeding the father, and crowned in the father's lifetime. It had at last come to be the strong ruler of a great and united nation, a nation which was the centre and core of mediæval civilization. It was impossible that so great a change, though it were but the accession of a near collateral, should pass unchallenged, and the challenge came from Edward III. of England. There was no claim worth calling a claim upon his part to the French throne, nor is it absolutely certain that at first he put forward the plea of blood. To inherit at all he would have to inherit through women, and even so he did not stand first in the succession. The policy of the French King in Flanders, his harassing of the great English trade with the ports of the Low Countries, afforded a pretext in 1336. In 1337 hostilities broke out; in 1339 the English King, Edward III., quartered upon his shield the lilies of France, which were not finally abandoned until the middle of the 18th century. And from that year may be said to date, in legal and heraldic theory at least, the struggle of the Hundred Years' War.

The epoch or trial upon which the French next entered, that of the Hundred Years' War, falls into two very distinct parts: In the first part, which corresponds roughly to the second half of Edward III.'s reign in England, successful and brilliant raids terminate in startling victories, and the French crown consents to abdicate a portion of its territory. During this first part of the wars, the armies proceeding from Britain were commanded by French-speaking nobles and a French-speaking King, and though the English language was in process of formation, and an English national spirit was already apparent, the whole thing was a chivalric adventure based upon the Gallic model. Then there was a lull, corresponding roughly to the reign of Richard II. in England, during which again the English lose ground.

At the end of Richard II.'s reign in England the Cadets of the Royal line, the House of Lancaster, usurped the throne. The usurpation was downright and even cynical—it was, of course, hateful to the morals of that time, nor could the Lancastrians maintain themselves in power save by a sort of reign of terror, coupled with a strict alliance with the wealthy and official class. Of all the elements which had gone to build up the English oligarchy, with the exception of the Reformation, none has been so powerful as this Lancastrian usurpation. The experiment rapidly led, as all such experiments have in all countries, to a foreign diversion. The war with France was renewed, but in a very different manner. The English king now claimed a real power. He was an English-speaking king, a soldier of extraordinary capacity, and very soon became, especially after his first great victory, Agincourt, a national hero. The old mad king of France in Paris was compelled to marry his daughter to Henry V. of England, and the rightful heir of France, the Dauphin, was thrust out, to the advantage of the issue of that marriage, who became the English king, Henry VI. What followed is common knowledge. Henry V. of England died; a vague national sentiment rose throughout French territory, and was embodied in the person of Joan of Arc. After one of those desperate and foot to foot struggles which are characteristic of French military history, the Capetian House gradually recovered all the territory which had been lost. The final expulsion of the last English garrison coincides, roughly speaking, with the close of the Middle Ages. This great struggle was accomplished within a few years of the development of printing and within a generation of the discovery of America.

A recapitulation of the main dates of the Hundred Years' War will not be without value to the reader.

Philip of Valois had his first engagement with Edward III. upon the fall of Cressy in 1346. The English, though a far smaller force, gained a complete victory. Immediately afterwards the town of Calais fell to Edward III. This did not lead to any immediate disintegration of the power of the French crown, though that power was gravely shaken. The next years were occupied with the great plague, the Black Death, which, though its effects have been so greatly exaggerated, especially by English historians, does form so deep a division across the history of Europe. These years indeed, though suffering from the English attack, saw an extension of the power of the King of Paris, for Philip bought the town of Montpellier in the South and acquired in full right a province which had now for 100 years been within the French orbit, the Dauphine.

Philip died in 1350. His son, John, was 30 years old on ascending the throne. The truce which had been established between the two countries had come to an end. The King of England again took advantage of the disturbed state of France (characterised by the convocation of the Northern States General in 1355) to push the attack. In 1356 the Prince of Wales, now a young man and an excellent cavalry leader (Edward the Black Prince), was advancing from the South while his father had sent a powerful army into Normandy. It was again a small cavalry raid supported by bow men that decided the issue. The terms offered to the French king by the Black Prince were refused, a battle was engaged near Poitiers, and not only resulted in an overwhelming victory of the small English forces, but in the capture of the French king. The result of this dramatic victory was the temporary dismemberment of the kingdom. The wealthy merchants and some part of the commonalty attempted a government under Etienne Marcel at Paris in the absence of the king, and convoked the National Parliament.

In 1360 John in his captivity consented to cede the Southwest in absolute sovereignty to England, and for the first time in its history a portion of the territory of Gaul was separated, though temporarily, from the National sovereignty. John returned and died in 1364. In the same year his son, Charles V., not quite thirty, that is, much of the same age as his father on ascending the throne, took over the government. He had already been the virtual head of the government for several years. Under him du Guesclin, against the spirit of the treaty signed with England, but with great courage and capacity, attempted the reconquest of French territory. A long Fabian series of skirmishes followed. The Spaniards defeated the English fleet at La Rochelle and permitted du Guesclin to recover Poitou from the English. Brittany, after the long doubt of the whole generation, began to support the French cause; Edward of England in his old age landed again, but his army was exhausted by perpetual dilatory tactics on the part of the enemy, it was virtually destroyed as a fighting force by disease and fatigue and ill-organization, and the old king of England died, after signing a disgraceful truce, in 1370. Charles V. of France held the throne till 1380. The country was impoverished, although the ancient power of the Crown had revived, and the new king, Charles VI., suffered on his accession from double disability. He came to the throne as a minor and he had madness in his blood. His very long reign (he was upon the throne for 42 years) led to nothing but disaster. The weakness of his character led to a struggle between two rival factions, known by the names of their leaders as the Armagnacs and the Burgundians. The Duke of Burgundy died in 1404, but his successor, John the Fearless, continued the struggle, seized the heirs to the throne and virtually governed Paris

The Armagnac faction, now deriving its name from a marriage of the heir of the Duke of Orleans with the heiress of that family, began to press upon the Burgundian power and was undoubtedly favoured by the people in general, and secretly by the poor king. The Gascons, the chief military element on the Armagnac side, were marching on Paris, a civil war of the most desolating kind broke out; when the moment appeared propitious for a new descent on the part of the English king.

In 1415 he landed in Normandy. It was originally, like the earlier wars, a mere raid, but it was far more successful than former raids had been. Normandy was completely conquered, after the utter breakdown of the French army at Agincourt, and finally on 21 May, 1420, the Treaty of Troyes was signed, whereby Henry V. married Catherine, the daughter of Charles V., and was declared heir in remainder to the Crown, with his descendants. The Dauphin was legally outlawed, and the position seemed secure for Henry, when in 1422 he died, succeeded immediately afterwards by Charles VI. after a reign of 42 years. There immediately began the struggle for the recapture of the territory, and that struggle was successful. Although a son had been born to Henry V. before his death, and had been solemnly crowned on his father's death, as Henry VI. of France and England, at the age of barely 12 months, the armies of the Dauphin began the reconquest. The chief elements in this were the defection of Burgundy, and the appearance of Joan of Arc. When the struggle had continued with doubtful success for seven years, this child of nineteen, confident of a supernatural mission, approached the court of the exiled Dauphin—Chinon, recognized there by some supernatural power both the King and various historic relics presented to her, relieved Orleans, had the Dauphin crowned in Rheims after a successful march across country, and in general roused in the army and the populace a confidence of success. She was taken prisoner in the second year of this marvellous career, outside Compiègne, after being wounded in her failure to capture Paris. She was sold to the English and burnt alive at Rouen. Nevertheless the English garrisons perpetually retreated or surrendered, and in 1435 the Duke of Burgundy himself abandoned the English Alliance, and with that act, of course, after the defection of so many of his supporters, all further English successes became hopeless. A few garrisons still held out, notably the St. Michael in Normandy, but Paris was taken the next year, and Rouen in 1453; and when Charles VII. died, in 1461, the French territory was clear. He was succeeded by a son who had rebelled against him, a man approaching 40 years of age, of a character dark, intelligent, very powerful and tenacious, deeply religious, and a little mad, known to history as Louis XI.

Louis XI., who next succeeded to the throne, had to meet a combination common enough at the close of any great epoch, coming as he did at the close of the Middle Ages; that is, a combination of forces which depended upon the ritual service still paid to old names and old ideas, but which only survived as clumsy anachronisms. In this case the forces with which he had to contend were the last forces of feudalism. Feudalism had long lost its vitality, and instead of having to meet a rebellion of local lords numerous and well-founded in their localities, he had to meet a combination of very great men most of them of blood royal but depending upon feudal theories and technicalities for their rebellion against him. His own brother, Charles of France, the Duke of Brittany, the heir to the Duchy of Burgundy, banded themselves under the name of «The League of the Public Good,» won the battle of Mont l'héry and proceeded as they thought to a complete success. It was here that for the first time Louis XI's powerful if not quite sane character appeared. He immediately gave way, where a weaker man would vainly have resisted, granted Normandy to his brother, made Saint Pol a Constable, and in general did all that could be done with the mouth and the pen. But it is a rule throughout French history that periods in which the French executive acts in this fashion, are those which accompany an increase of force for such an executive, and for the nation. Within three years of the defeat he summoned his Parliament at Tours. The nation as a whole was now, as always, in support of the Crown against the wealthier merchants and the aristocracy. Louis received the strongest popular support, he incited the commercial towns of the Lowlands to rise against his enemy of Burgundy, he organized the military force of Paris, and though Charles of Burgundy, who had now succeeded to that throne and who is known to history as Charles the Bold, was still far stronger than the French king, compelled him to attend the sack of Liege and even to sign the Treaty of Perronne in which Louis granted Burgundy complete independence, the Capetian could not but win. On his return to France he summoned an assembly of the notables, they denounced the Treaty of Perronne, and Charles of Burgundy's invasion of France which immediately followed was checked by the resistance of Beauvais. Everywhere in the Lowlands, in the heart of France, in his parliament and in the small provincial towns, it was the Commons who sustained Louis XI. And the Commons in France were beginning to be that which they had long ceased to be in England, peasants and small tradespeople. For in France the end of the Middle Ages tended to be democratic: in England aristocratic.

The end of Louis XI's reign emphasized at once his curious character and his successful policy. The extravagance of his religion, and the cruelty of his revenge were never more apparent than in the last years of his seclusion; and yet it was during these last years that the death of Charles of Burgundy in battle against the Swiss, gave him that province. When he died on 30 Aug. 1483, with all the provinces he had reunited to the Crown he governed almost automatically by far the greater part of the territory of modern France. Brittany alone was quasi-independent.

His son Charles was only 13 at his father's death, and the kingdom was under the guardianship of his elder sister Anne. She was well served. A second revolt of the great men in the kingdom was crushed at the battle of Saint Aubin du Cormier, and five years later Charles VIII. having now freed himself from his sister's power, married the heiress of Brittany and united that province to the Crown. He next invaded Italy in pursuance to a claim to the throne of Naples. The military result was small, but the moral results large. First, and by far the most important, the military temper of the nation was given an opportunity to exercise after the long and successful diplomacy of his father. Such foreign wars have always been of the utmost stimulant effect upon Gaul. And the second result was the introduction into France of the Italian Renaissance. When Charles VIII. died, still quite a young man, in 1498, he was succeeded by the Duke of Orleans, a distant cousin of his, the great grand-son of Charles V., who was the nearest male heir, and who had led the great insurrection of 12 years before. This prince, among the most sagacious and temperate of all European kings, insisted as a matter of policy upon renewing the Breton marriage, though the experiment was perilously near incest, continued the Italian invasions, effected an alliance with Henri VIII., marrying Mary, a sister of that king, and died on the first day of 1515 with power more complete, a territory more united, and the military organization of the kingdom more thorough, than any of these factors in French history had hitherto been.

This date, the opening of the year 1515, is of such moment for France and for all European civilization, that a short digression is necessary in order to appreciate the change we are about to witness.

The change which fell upon Europe in these first years of the 16th century is not one to which precise causes can be ascribed: it was rather one of those whirlwinds which appear to blow from without the field of material observation and of material causation, though it is indeed true that the mind of Europe had been stirring uneasily and with increasing force for three generations past. The movement which was to be of such prodigious consequence, and to which we owe the modern world, took two forms; the first of which was evidently of vast moment, the second of which at first appeared to be a particular and local phenomenon. The first was an extension of human knowledge and a rediscovery of the past. The second was the revival of those interminable theological discussions which had been wearily familiar in Europe for more than a century past. The revival of learning, the discovery of antiquity, the expansion of the known world and so forth, for a hundred years occupied the chief energies of men, but side by side with that great wave of change, went with expanding force the theological discussions of the time, until their united effect was such as to split asunder the unity of Europe; that unity has not yet been regained, though it very nearly was under Napoleon, and though the trend of things to-day is to achieve it at the expense of bitter conflicts. When this enormous result of pettifogging theological discussions was apparent, even educated men woke up to the importance of what had hitherto been a by-product in the general intellectual movement of the time.

This waking up, so to speak, to the importance of the religious quarrel, took place in the middle and towards the end of the 16th century, but it was not until the 17th century had opened that the schism was irredeemably fixed or that the division of Europe into two camps of opposed thought and morals was reluctantly accepted. This period of ferment is covered in French history by six reigns. That of Francis I., from 1515 to 1547, very nearly contemporary with the reign of Henry VIII. in England, was occupied with the glories of the Renaissance. It also corresponds to the reign of the great Emperor Charles V., and covers the first stage of the theological discussions already alluded to.

The first ten years of Francis I.'s reign were occupied with foreign ambitions, and were closed by his defeat at the Battle of Pavia in 1525. He was defeated, and only obtained his liberty with difficulty. The remainder of the reign is concerned with the transformation of architectural and every form of plastic art under the inspiration of his court, and quite late—in 1535—it was occupied with the beginning of the persecutions, an attitude which is retained during the remaining twelve years of the reign. Meanwhile, however, as the middle of the century approached, and as the principles of the Reformation obtained hold in Germany, the French kings saw the opportunity for maintaining the independence and increasing the greatness of France, against the overwhelming power of the Hapsburg House which surrounded them on every side, in Spain as upon the Rhine, and in the Low Countries. This opportunity was afforded by the Reformation which was supported in Germany as everywhere, by the squires and the great merchants, and all those who desired to break from the central authority of the Crown. From this period, for full 200 years, it was the constant policy, now more, now less active, of the French monarchs, to support the petty Protestant communities against the general authority of the Empire.

The next reign, that of Henry II., was imbued with this idea, although the repression of the Protestant movement at home was continued.

Charles V., who had survived Francis, engaged in war against that policy, but was checked by the defence of Metz. At the end of the reign, in 1559, Henry II. had done little to check the growth of Protestant feeling in France itself, had powerfully aided it in Germany and had secured for the French Monarchy the district of the three bishoprics. The wife of Henry and the mother of the next three kings was a Medici—Catherine, a woman of singular courage, probably corrupt in temper, and certainly in physique. The first two of her sons to succeed, Francis II. and Charles IX., were not quite sane, and were even more uncertain in bodily health than in mental. The theory of monarchical government which was increasing in power daily in the French mind, was weakened in practice by the spectacle of these two debilitated men. The country was in active quarrel between those great families who sided with the Reformers and those who maintained the defence of Catholicism, while the Crown was at times nothing but a pawn in the hands of either. It must not be supposed that the division really lay along philosophical lines. Nothing was commoner than for a man to appear first upon one side and then upon the other; but the progress of the Reformation was producing such an effect throughout Europe that its principles made a convenient line of division for warring factions. Meanwhile the populace, whom these factions of the upper class confused, were very strongly in favor of the national tradition, and consequently increasingly hostile to the Reformers. The feeling became acute in the town of Paris, where the adherents of the Reformation were very wealthy and powerful, and into which were already beginning to crowd those who expected a political or a diplomatic career. The natural jealousy of wealth, coupled with the indignation against the new theories (which were openly placarded in the street, often in the form of violent insults to the popular religion) led to the explosion known to history as the Massacre of Saint Bartholomew, a piece of bloodshed which, though it was less in extent than many, must rank in history as one of the great Parisian days of violence, and takes its place beside the attack upon the Commune and the Massacres of September. (See BARTHOLOMEW, MASSACRE OF). How far the Queen Mother took advantage of the popular exasperation against the Huguenots, it is quite impossible to say. The legend that the King fired a shot by way of signal has been exploded, but it is probable that the sympathies of the Court in favor of suppressing one or other of the factions were sufficiently strong to have led to active intrigue, and it is equally probable that the popular feeling was let loose by the Crown.

Whatever the causes—and they will never be fully determined—the effect of the Massacre of Saint Bartholomew was to make Protestantism impossible as the national religion of the French.

But some years later the death of the remaining son of Catherine de Medici, brother and heir to Henry III., who since 1574 had been on the throne, left no male descendant of the Capetian House save Henry of Bourbon, the son of the King of Navarre, to whom he immediately succeeded. Now the House of Navarre had, through the influence of Henry of Bourbon's mother, supported the Reformation: not in its moral aspect but as a piece of protest against the central authorities of Europe. Henry of Navarre had no great attachment to the system on its political side, none on its theological, and an active dislike of it in its moral aspect. He was for his friends a hearty liver, for his enemies a libertine, and above all a highly successful soldier. The town of Paris under the influence of the family of Guise, went so far in its hatred of the Reformation as to refuse the quite unchallengeable claim of Henry to the throne, because his name was connected with the Protestant side, and because in the recent civil wars those who were now the members of his army, had in the main been fighting for the Reformation. Under the authority of what was called "the League," Paris refused to accept Henry of Navarre's heirship to the throne, and when in 1588 Henry III., the reigning king, had procured the death of the Cardinal Guise, and, being excommunicated for that act, joined Henry of Navarre and took refuge in his camp, Paris declared not only against the succession of Henry of Navarre, but also against the reigning and legitimate king.

In August 1589, that king was stabbed and killed by Jacques Clement. Henry IV., as Henry of Navarre must henceforward be called, was successful in the field, but was unable to take the capital; and his final admission within its walls must not be ascribed to purely military success. It was rather his personal character which gave him popularity in every circle that he led, whether military or civil, his tenacity and the growing absurdity of the attempt to put a subject upon the throne, as well as the adhesion of the remainder of the country, that slowly converted Parisian opinion. Henry IV. was ready to meet this process of conversion halfway. Within four years of Henry III.'s death (in July 1593), he abjured heresy at St. Denis just outside the walls of the capital, and next year was secretly admitted by night. The Pope accepted his reconciliation with the Church; he became immediately popular with the town of Paris, and from this date begins his true reign over the French people.

The first and most turbulent period of the religious quarrel in France ends with the Edict of Nantes, signed by this monarch in 1598. It is a document of capital importance, the first of the three great steps by which modern religion has been affected in France; the fourth of which, though already imminent in France, has not yet been taken. These three steps are: The Edict of Nantes, its revocation less than a century after it was promulgated; and the virtual secularization of the State by the French Revolution. This last or the third step, in its turn has been followed by a reaction towards Catholicism which may at any moment produce, as I have just said, a fourth landmark in the history of the French religion; but this modern process does not concern these pages.

The Edict of Nantes was remarkable in several ways: It was the first and almost the only document to grant religious toleration in its time. For three generations during which it was death to say mass in Protestant England, a Protestant in Catholic France enjoyed all the facilities of a citizen and many special privileges as well. The principle was recognized that if a religion alien to the body of citizens was tolerated at all, it must be tolerated as a privileged and exceptional thing. The Huguenot body which was then somewhat more numerous than it is to-day, and may have amounted to 5 per cent. of the population, was not only permitted to hold any office but was allowed to organize its interior life, to hold gatherings at regular intervals; to decide upon the attitude which it should maintain towards the rest of the State; and even to possess special towns as its places of refuge. The settlement was not wholly successful, as will be seen by what follows; but though it worked under an increasing strain, it was not definitely put aside until the reign of Louis XIV. and the two other generations during which it was in vigor, nourished the small but wealthy Huguenot body, permitted it to strike deep roots, and to become what it still is, though it has dwindled in numbers—a powerful alien element in the midst of the French State.

With this date, 1598, and with the signing of the Edict of Nantes, much more than with the end of the reign, the next period of French history may be said to begin.

After the settlement effected by the Edict of Nantes the energies of Henry IV. were given up as his temperament demanded, to aggrandizement, for it is remarkable that all those who acquire power over the French are tempted in a short time after that acquisition to theories of military expansion, finding in their hands the best material in Europe for such a purpose. The plan of Henry IV. was clear enough, and though it has been termed immoral was none the less patriotic. He proposed a destruction of the only strong and centralized power opposed to his own, that of the House of Hapsburg, and he would have accomplished this at one stroke by the use of a powerful army, after which it is just possible that he intended to assume the headship of Europe and to impose peace. In this task or ambition he was aided by the great Sully, a man avaricious in temperament, orderly, careless of divine things, but undoubtedly courageous. The plan of the war was to help the petty German principalities in their attack upon the central power of the Emperor. The greater part of these petty principalities were naturally protestant, for protestantism had been for them the religious aspect of their political claim. Germany was therefore supporting them against their traditional authority, whether civil or religious. All was ready for the expedition, when on 14 March 1610 Henry was stabbed by Ravaillac on his way to visit Sully at the Arsenal. Many prognostications and omens had foretold this murder, the motive of which was the popular exaggeration that Henry's plot involved a war against the Pope himself and the Catholic Church. Henry was succeeded by his son Louis, the 13th of that name, then in his minority. The Queen Mother, Marie of Medicis, was Regent. She ruled with great individual power and singular energy, but perhaps with insufficient judgment. And the point was of importance because all Europe was then in the great settlement of the quarrel which the Renaissance and the Reformation had aroused.

Roughly speaking, from this moment the Protestant nations tend (a) to become oligarchic, that is to be governed by a clique of wealthy men; (b) to develop an intense local life; and (c) to deny in practice and in theory the unity of European civilization; for instance, it is amongst them that the Jews began to be treated as citizens not distinguishable from the Europeans round them. Such communities as had preserved the older philosophy tend, on the contrary, to egalitarianism: first, under the form of despotic central powers, later under the form of democratic experience. England, Holland, the Protestant Swiss cantons and the Protestant principalities of Germany and Scandinavia, tend to oligarchy and all its consequences. In England itself a great civil war was about to break out, primarily oligarchic in its origin, that is, having for its motive the determination of the squires and the big shop-keepers and merchants to govern the common people and to oust the King. But France remained the arena. The Protestants were immensely powerful; they had cities of their own, forming as it were a state within a state; they were still very numerous (forming perhaps a quarter, perhaps a third of the well-to-do classes), and the generation which could remember, whether in France or elsewhere, the old unity of Europe in philosophy and government was dead. The force of Protestantism in France lay of course upon the side that Protestantism took all over Europe, against central monarchy, in favor of oligarchic theories, and of the independence of the great landowners and of the great merchants. Had the first years of Louis XIII.'s minority been under the hands of some one strong man, France might at once have become the one thing or the other. As it was, sufficient interval was allowed for the Huguenot theories of independence to take root. It was not until 1617 that Louis XIII., now in his 17th year, began to act upon his own initiative. Much at the same moment there appears in French politics the great personality of Richelieu (q. v.). He was of the squires family, by name du Plessis. He had been trained to the Church, was poor, but had sufficient influence to be made Bishop at the age of 22. The meeting of the French Parliament or States General in 1614 (when he was not yet 30) had brought him into some prominence, for he was a member of the House of the Clergy. Two years later, in 1616, the Queen Mother with her keen Italian eye, picked him out for the ministry. From that moment he is the principal figure in France. A quarrel which Louis XIII. engaged in against his mother eclipsed Richelieu for a moment, but when that quarrel was appeased she used her influence to have him made Cardinal (in 1622), and in 1624 he entered the Council of the King, never to leave it, and to direct it during the remaining 16 years of his life with despotic power.

Richelieu, like all men who count in history, had a very simple plan, if it may be called a plan at all. He was determined to aggrandize the material power of the nation. He had, as have also all great men in history, not a simple but a highly complex and subtle appreciation of the medium in which he lived. To him is due that «rediscovery of the national soul,» which in France is only satisfied by unity and rapid centralized measures. He made short work of the Huguenot pretension to maintain within the State a body of rich men defying the authority of the State. He took, after a most gallant and savage defence, the protestant stronghold of La Rochelle, in spite of the active aid of foreign enemies, whom the Huguenots had at once summoned to their aid, and by the Peace of Alais in 1629 he destroyed their conspiracy. He left them, however, complete liberty of conscience, a stroke of statesmanship as wise as it seemed (at that moment) enormous and paradoxical. At that moment and for long years afterwards it was death to say mass in England and no Englishman could have understood the ideas of toleration at all. Neither did any Frenchman understand it as an idea, and Richelieu probably thought it illogical himself, but he forced it on the French in spite of civil war, as a measure of statesmanship.

He was not content to destroy the root of rebellion; he was also determined to destroy what was left of the ambition of the squires, apart from any religious or philosophical attitude their class might have adopted. He took the occasion of an excess in the practice of duelling to execute more than one great Catholic noble who persisted in flouting his decree against that habit; in a word, before the outbreak of the Civil War in England, he had made of France one united country in which the power of government was observed by all, and in which all tendencies to oligarchy had been utterly destroyed.

Abroad his policy was naturally the very opposite. As he had desired to strengthen France, so he desired to weaken her rivals. With this object he ardently supported all tendencies to division beyond her frontiers, and notably the claim of the German Protestants against what had a hundred years ago been the common civilization of Europe. There had broken out in Germany in 1618 the war known as the Thirty Years' War (q. v.) in which the small Protestant parcels, notably those whose conversion to Christianity was recent and whose foothold in European civilization was still insecure, had determined to break off from that tradition by the sword. Their cause was hopeless in Germany itself, but Richelieu threw the whole weight of French influence upon their side. In about 1635 the Empire and the old traditions of unity were completely successful, and in the same year France declared war against the Empire. The Spaniards invaded and were with difficulty repelled, but in the next few years the French armies occupied the Roussillon (which is now the Department of the Pyrenees Orientales), and when Richelieu died in 1642 and, some months after him, the King, Louis XIII., a definite French success was approaching. The young, brave, eccentric and somewhat taciturn prince of the blood, Condé, then Duke of Enghien, delivered the fortress of Rocroy on 19 May 1643, and five years later in company with the great Turenne, he accomplished for his country after the most striking military successes, the Peace of Westphalia, by which, in 1648, the Protestant principalities,—and notably, the sandy wastes whence has sprung the kingdom of Prussia,—were created independent units, and the power of the Austrian Empire and of the old traditional central authority in Germany, finally wiped out.

The centre of the 17th century, like the close of the 16th, and like the year 1515, is a date upon which all historical students should repose. Another stage in the great quarrel was accomplished, and the schism of Western Christendom was signed and sealed. Within a few months Charles I. was to lose his head and the English were to lose forever the conception of monarchy and perhaps forever, the sentiment of civic equality. Germany, though destined perhaps ultimately to be reunited, was for 300 years left torn between the old Roman civilization and the barbarism of the North. France, the agent of this vast Protestant establishment, had, so far as domestic politics were concerned, welded her unity, re-established her own traditions, and crystallized into the highly definite modern form, which she not only preserves to this day, but seems destined to preserve indefinitely. There was not yet a code of laws, the old gimcrack pretensions of the nobility were still strong, but the whole spirit of the people and of their literature, had become again egalitarian and Roman, and the destiny of the next century and a half might be predicted from the Peace of Westphalia.

Meanwhile Louis XIII. was dead, a little child six years old, another Louis, his son, was upon the throne. The regency was again in the hands of a woman, and when this great development before mentioned was in process, the government was in the hands of Anne of Austria, the Queen, and of her favorite, an Italian of great subtlety and low birth, known to the French as Mazarin (q. v.).

Mazarin was not only lowly born and subtle; he was also extremely fond of money. But he had all the Italian conception of what is august; he had inherited the tradition of Richelieu; he maintained it, not nobly but by successful intrigue. He managed to wear down the tendencies of revolt on the part of the nobles which still remained (the greatest French generals, Condé and Turenne himself mixed in that revolt) and when he came to die he left to the boy, Louis XIV., then but 23 years of age, a complete inheritance of a thoroughly successful foreign policy (the Peace of Westphalia was 13 years old); an altogether independent personal despotism in the hands of the King, and a nation so organized in literature, in self-appreciation and in common morals as to form a completely homogeneous body in the Europe of its time. With that year (1661) in which Mazarin died, corresponding within a few months to the restoration of the impoverished, undignified and salaried monarchy made in England, begins in actuality the peculiar and (in the eyes of contemporaries) the glorious reign of Louis XIV. A boy of 23, as has been said, on his virtual accession, he reigned until 1715, a period of 54 years, and from the habits of the generation formed in that space of time, descend the 18th century and the Revolution in France, and, in a sense, modern Europe.

The reign may be conveniently regarded in three periods. The first, of 17 years, covering Louis' active manhood and taking one to his 40th year, was principally composed of successful warfare. And the Peace of Nimeguen in 1678 terminated a successful and advancing struggle against what had become a coalition of the smaller powers against his throne. From that period till close upon the end of the century, the very rapid perfecting of French life which was setting, as it were, into a clear classical form, tempted him to that great sin of every French leader, which is ambition. With such armies and with such an intelligence as his allies, he began to dream. There was even for a moment a danger of the French Church becoming national and losing the spirit of Catholicism. The combination against him continued to exist, and in the midst of this period the final victory of the English aristocracy over the Stuarts threw a heavy weight into the scale against Louis XIV. He was a man of strict honor, and his policy as well bade him support the claim of James II. and of James II.'s son. He had against him, therefore, from 1688 onward, the whole force of the governing power in England as he had already had against him for 20 years the whole force of the governing power of Holland. To this period also belongs (in 1685) the most disputed act of the whole reign because it was the one which most nearly touched the interests of those opposed to the French people, the interests of their philosophy that is, and by philosophy alone do communities live. This act was the revocation of the Edict of Nantes. From that date it has been a fixed article of French policy that the State shall be one, and that no power within the State shall be permitted to exist. There was a vast outcry against the victims of this determination for unity; logic demands that a similar outcry should be raised against the persecution of the priests under the Revolution, of royalists under Napoleon, of the religious orders in modern France, and of countless other instances of minorities which this cardinal principle has caused to suffer. It was not of course a personal act of Louis XIV., it was but one further stage in the maturing of that principle of absolute unity, which had been growing in the French mind since the opening of the Middle Ages, and which had acquired such open symbols upon the accession of Henry IV.

In the third period of his reign, as an old man, Louis XIV. engaged upon the last great struggle of his life. The King of Spain, Charles II., had left the crown of that country by will to the young grandson of Louis, Philip, Duke of Anjou. This was in 1700. It was debatable whether Louis XIV. should accept this onerous honor or not; he determined to accept it.

It must be remembered that until within living memory, monarchy was a real political principle. Those who now exercise the function, make us forget what a very real thing a reigning family was up to the moment when the French Revolution had worked out its full effect. For members of one family to rule over France and Spain at the same time had something of the same effect on contemporary imagination as would have today the declaration by one great power that it was determined to annex the territory of another. War flamed at once throughout Europe. It was one of those contests in which the French nature was in real peril and in which defeat seemed certain; one of those contests of which the two other historic examples are the invasion of Henry V. and the German war of 1870-71. Upon this occasion, however, there was toward the end of the struggle a rally which prevented the consequences that followed upon the earlier and upon the later occasion, and when the Treaty of Utrecht was signed (as well as those of Restadt and Baden) in 1714, the honor of the country and of the monarchy was saved. All that was lost by France was colonial territory to which at that time no more importance was attached than is attached by us today to the impoverishment of the laboring classes of a nation, or to the loss of its religion, for no generation is capable of foreseeing the future.

The next year the old King died, leaving for successor a little child, his great grandson, who is known to history as Louis XV.

During the minority of this child France was in the hands of the Duke of Orleans, acting as Regent. The Regent had all the qualities that we admire in man, especially that of courage. He was a gentleman, and thoroughly generous; but he was a libertine, and this weakness of sensuality marred both the dignity of his position and the efficacy of his government. His counsel, the Cardinal Dubois, was probably most unworthy, but one must be careful not to exaggerate one's impression of him, for the attack upon authority was already beginning, and the fact that Dubois was in orders was quite enough to make the intellect of his time emphasize his vices. After a period of violent speculation and of great though perhaps exaggerated public distress, the Regent died, having held his authority for eight years. From that moment (1723) Louis XV. began to reign.

Nothing is more difficult than to estimate the character of this man. It cannot be denied that upon this character the history of France during the next 70 years largely depended. For the monarchy was still real and absolute and the method in which it was conducted was the chief factor of the national destiny.

The writer of these lines has minutely examined the acts, the portraits and the handwriting of Louis XV., and in relation to a monograph concerned with that period, has made himself thoroughly acquainted with the personality of the man; and yet he finds it very difficult to give a true judgment. He was profoundly Christian, with a fervor of religion that verged upon superstition; he was undoubtedly courageous, somewhat sensual, in old age excessively so. On the other hand he suffered from an impediment of the will. To say that his will was weak would be to convey a very erroneous impression. But there were a certain number of things he could not bring himself to do, and chief of these was the exercise of authority face to face. He hated and avoided all interviews and all scenes. In his character of gentleman this was well enough, but in his character of King it was fatal. The first war of his reign was upon the whole glorious. And the Treaty of Vienna, signed in 1738, gave France the reversion of Lorraine. But two years later the principal quarrel of the century and the most important event, in its effects between the English Revolution and the French, took place. This was the death of Charles VI., the Emperor of Germany, who left as heir his daughter Maria Theresa. The German anarchy was at once aroused. The attempt to destroy the empire virtually was begun by the Protestant princes, and notably by the rising power of Prussia. At this moment a clear error, one of the very few with which French diplomacy can be reproached, was committed. Two centuries of tradition proved too strong for the French intellect, and the French armies were allied with those of the petty princes and of Prussia against Austria. The origin of the war was marked by the first of those scandalous acts which have brought European civilization into such peril during our own time. Frederick II. of Prussia, a man subject to every vice, with the exception of cowardice, seized Austrian territory without title and without any declaration of hostilities. It was the act rather of an Asiatic than of an European. But the French monarchy, whose whole history had been a protest against such a perversion of public morals, found itself in alliance with this detestable soldier. The alliance was not unsuccessful, and the war which followed will be forever famous in French annals from the great victory of Fontenoy on 11 May 1745, a victory largely due to the Irish exiles who fought under the French flag. The Peace of Aix la Chapelle signed in 1748 did not show the fruit of so much military valor and success; it left France very much as it found her. But the struggle with its false issues and its vanity had luckily converted the French diplomats, and henceforward France wisely associated herself with Austria, with the especial purpose of meeting the rising power of England. Had the French forces been confined to the struggle with England, their success, which was already great at sea, would probably have been final, and the strange spectacle would have been presented in our own time of a France weighted with eccentric, un-European colonies, and probably deprived of its whole national spirit and tradition. The reason that we have no such spectacle to enjoy or deplore is that the government of Louis XV., not content with fighting England abroad and at sea, undertook a continental campaign, and fought side by side with Austria in what is known as the Seven Years' War (q. v.). At the very beginning, in 1757, Frederick of Prussia inflicted a crushing defeat upon the French at Rosbach, a defeat entirely due to the ineptitude of the French command. Meanwhile in the colonies the French lost and the English won. And in 1763 the Treaty of Paris was signed, which for a century destroyed all French effort oversea, left Canada to the English, abandoned India, and, what was graver in the history of European morals, permitted Frederick of Prussia to retain Silesia, thereby acknowledging in a public instrument for the first time since the foundation of Christendom, that lawful succession and inheritance might be waived in presence of force. From this grave crime Europe still suffers. It was the precedent of all the international anarchy which our generation has almost become accustomed to.

The remaining 11 years of the reign were passed in peace, but in dishonor. The nation was profoundly troubled in its pride as in its economic circumstances. The heir to the throne was a lanky, very stupid boy, the grandson of the old king, and men saw nothing in the immediate future for their relief, though the death of Louis was looked forward to as to an event for public rejoicing. He passed, after a few senile years of debauchery, in 1774, and his grandson, Louis XVI., who had been married as a boy (four years before) to the youngest daughter of Maria Theresa, Marie Antoinette, ascended the throne. On the same day the Boston Harbor Act was proclaimed in the American colonies. It is quite impossible in a few short notes such as these to prepare the reader for the enormous convulsion through which France and all civilization was now about to pass. It is enough to say that the mind of that generation was by this time securely fixed in a clear and intense conviction: that lucid, mechanical and direct methods capable of reasonable analysis were in all departments of human energy the only ones which man as a moral being could entertain. It followed that all merely organic things were in peril, the old and merely traditional constitutions of the country, and of course religion. The Catholic faith had never been at so low an ebb since Constantine; its power has been returning for a century, and it is difficult for our generation to understand how completely the faith had disappeared just before the French Revolution broke out. The first years of Louis XVI. were occupied with a renewed struggle against England, which struggle was successful beyond the dreams even of those who most ardently supported the policy of attack. French guns had been supplied to the army which conquered at Saratoga shortly after a French fleet rendered possible the surrender of Yorktown; and it was imagined both in England and upon the continent (such is the impossibility of foreseeing the future) that the power of Great Britain was finally extinguished. Meanwhile, the American colonies and their ideal republic furnished an object lesson, as it were, to the rationalism of the time. And the public mind was moving very rapidly indeed towards a reconstruction of society. The moral equilibrium was utterly unstable. It needed but some material cause for that equilibrium to be upset, and for a new society to arise. This cause was presented by the condition of national finance. France was a very wealthy country and like all the rest of society at that moment, was rapidly increasing in wealth. But the methods of taxation were grossly imperfect, the burden fell upon the wrong people, and was imposed in the wrong way. So that France could with difficulty furnish a sum equivalent to no more than five dollars per head of its population, where today it furnishes with the utmost ease close upon and often exceeding, 20 dollars a head. An assembly of the notables of the kingdom was summoned in 1787 and did nothing. And finally in 1789 was convoked the first great democratic parliament ever seen in Europe since the Middle Ages had declined. The experiment was watched with alarm, especially in England, where the conception of popular government was mistrusted and disliked, not only by the ruling oligarchy but by the people themselves. When the assembly had met, which was in the May of that year, the commons proceeded to claim in practice complete power in the State. They had for their ally the city of Paris, without whose energy and courage their rhetoric would indeed have been vain. The mobs of the capital proved incapable of withstanding regular troops. That was the chief and least understood aspect of the Revolution. Nor can any unacquainted with the military temper of the French people comprehend the movement. It was, for instance, Carlyle's principal error that he imagined a display of public force sufficient to check the Revolution. Public force was used to the utmost, and failed because the people were in a mood of indifference to suffering and to death, a phenomenon so rare that, save in Ireland, the modern world has seen no example of it. It is possible that a democracy would have been established and that the names at least of certain great traditional functions in the State would have been preserved, and that the Revolution would have ended in a compromise, had there been no foreign war. As it was, the attack made upon the organization of religion, and the attempt to withdraw the Catholic priesthood from their normal organization and to make of them a civil service, coupled with the perpetual indignities offered to the King and Queen, and added to the ceaseless effects of violence, moved Europe to interfere. The method of this interference was cautious and long debated, but the threat of it was enough to goad the French people. In June 1791 Louis XVI. and his wife and children fled to the frontier and were recaptured. Two months later Austria and Prussia publicly agreed upon a policy of intervention, though even at this late stage the agreement was conditional, and so far as we can judge by the private letters exchanged in that autumn, the idea was rather to overawe the French democracy by a display of invincible force, than to proceed to actual invasion. In the winter, largely through the action of Marie Antoinette, Austria, ruled by her brother, proceeded to impose minor but direct commands upon the French policy. In the spring war was declared. The allied armies did not cross the frontier until the height of summer, but it appeared certain that they would be in Paris by the end of August, for the disorganization of the French army was complete and it was quite incapable of making a stand. The invasion was accompanied by a manifesto drawn up by advice of Marie Antoinette (who was probably the author of its principal threat) and this manifesto devoted the town of Paris to military execution, if the persons of the royal family were not left inviolate. The answer of Paris to this document was to storm the palace on 10 August. The building was well defended by a powerful force of 6,000 men, and it was the opinion of Napoleon Bonaparte, who seems to have been an eye witness, and who was certainly an excellent judge of military affairs, that the military chances were in favor of the crown. The mob fought with the utmost courage, losing men in numbers variously estimated at 150 and 3,000,—the latter is the nearer computation, for though the losses were heavier of course upon the defeated side, the services of numerous carts and carriers were required for the whole day and the succeeding night in removing the dead. At any rate the populace were completely successful. The royal family was imprisoned and a committee of extreme democracy, the chief of whom was the learned but impetuous Danton, took over the management of the country in the face of the enemy. That enemy proceeded without obstacle, forced the three passes of the Argonne, and met such forces as the French had scraped together on much the same ground as had seen the struggle against Attila, the great plain now occupied by what is called «the Camp of Châlons.» The center of the French position was the windmill of Valmy. What followed is a singular lesson in strategics. There was, properly speaking, no battle. A distant cannonade and an abortive charge made up the whole action. But precisely because the Duke of Brunswick did not press his power home Valmy had all the effect of a thorough defeat. A retreat was negotiated, and from that day, the equinox of '92, the Revolution took on its final phase. The republic was declared, the trial of the King was prepared, the army though still undisciplined and unmilitary gained the haphazard victory at Jemappes, and poured over the frontier into Belgium. On 21 Jan. 1793 the King was executed; within a fortnight Holland, England and Spain, one may say the whole of Europe, was at war with France. The volunteers and other hotch-potch under Dumouriez in Belgium were defeated; at Neerwinden, Dumouriez betrayed the country and ultimately accepted a large salary from England, whose strategy he advised and overlooked, and the French Revolution, for the second time in peril, established martial law. A strict military despotism in the hands of a small committee, known as «The Committee of Public Safety,» governed France with ruthless severity for 16 months, defeated the enemies of the country and began that marvelous series of victories which within a generation transformed the world. During those 16 months the committee was changed; but its principal names give it unity from first to last, and in its latter stages the name most upon public lips was that of Robespierre (q.v.). Robespierre did not command the committee. They were at first jealous of him and toward the end of the period he hardly attended their meetings. He was a man of many virtues, of a high political idealism, and of conspicuous sincerity and candor, but he suffered from the vice of ambition. He loved the popular idolatry that surrounded him, and used it as a lever against the committee. This committee, therefore (in which he had but two friends), being essentially military in its nature, and occupied principally in the military problem of repelling the foreigner, determined to be rid of him. They planned his destruction, and Robespierre was outlawed and guillotined on 28 July 1794.

It so happened that the period of his great popularity had coincided with the height of the revolutionary delirium. Three-fourths of the country was in revolt. Savage acts of repression had followed the crushing of the rebellions and «the Terror,» as it was called, had come, very falsely, to be associated with Robespierre's name. When he fell, therefore, the committee found to their astonishment, that his fall was taken as a signal for the relaxation of their military power. From that date (called in the new revolutionary calendar «the Tenth Thermidor») the active portion of the Revolution ends. It had succeeded in finally establishing the theory of democracy.

In the next year it achieved its most diplomatic success, and imposed peace upon its enemies at Basel in a treaty which considerably enlarged French territory, and shortly afterwards the public assembly which had accomplished this great result was dissolved. England

and Austria alone remained at war. Against the second was despatched into the Plains of Lombardy a young Corsican who had but lately been given his brigade, and who was but 27 years of age. This man was Napoleon (q.v.) and from that date, 1796, the history of France begins to be a record of his exploits.

See Clovis; Charlemagne; Charles Martel; Pepin; Paris; Crusades; Hundred Years' War; Joan of Arc; Henry of Navarre; Guise; Edict of Nantes; Henry IV.; Sully; Louis XIII., XIV., XV., XVI.; Richelieu; Thirty Years' War; Condé; Turenne; Mazarin; Maria Theresa; Seven Years' War; Frederick II. of Prussia; Marie Antoinette; Mirabeau; Danton; Robespierre; Marat; Girondist; Reign of Terror; Napoleon; France—Church and State; Great Britain—French Wars of the 18th Century; United States—The Revolution; Italy—Modern History; Germany—Political History; Austria, and the various personages and events mentioned in this article.

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Hilaire Belloc,
Author of "Danton," "Robespierre, etc.

3. France—History from the Revolution to the Establishment of the Empire, 1796–1804. This period is one of the most important in the history of France, and from beginning to end its every event centres about one man — Napoleon Bonaparte. But from the outset, Napoleon was greatly hampered. There was much popular unrest, for the people had but recently emerged from a bloody revolution and were clamoring for they knew not what. The main foundations of democracy had been laid, but the fundamental principles of civil and religious liberty cherished by the French people, equality of rights and the sovereignty of the will of the people, seemed as yet insecure; petty jealousies, conspiracies, plots and counterplots dominated politics. The government was internally weak, and engaged in a struggle for its very existence; the directors, honest men enough, never were in harmony; suspicion and distrust of everybody and everything pervaded the atmosphere; the finances were in a disgraceful condition; the nation, weary of internecine warfare, sick of bloodshed, longed for permanent peace and a renewal of industrial and economic activities, but industry and commerce seemed dead, or at least in a hopeless state of stagnation; bankruptcy overwhelmed the bourgeoisie; the laws were unsatisfactory and, poor as they were, remained unenforced; the army, though re-enforced following the Revolution, was in a very bad condition, ill-fed, poorly clad and lacking a controlling hand; and relations with foreign nations were strained to such an extent that war threatened on every side; the aggressive policy of an unstable government bade fair to lose to France the glory of her recent conquests. War seemed now to be the only means of replenishing an empty treasury, and confirming the glory of the nation through the work of her military commanders. The first significant step in his path toward power was the placing of the armies of France under Napoleon's command and at his disposal. Thus the opportunity was within his grasp and the means provided whereby he could carry out his personal ambitions and at the same time promote the progress and welfare of the entire nation. Possessed of great wealth, acquired by plunder, Napoleon was enabled to supply the Directory with much needed funds and to bend the will of that body to his own ambitious ends. Peace-loving Frenchmen grew to place fullest confidence in this irresistible chief of the army. That this revivified military force and its ambitious commander should ever become a menace to the designs of the Directory and of the citizens of France was not contemplated. Whether or not his love for the country or his commiseration for the pathetic state in which he found her were secondary in his mind to his personal aggrandizement matters little. It is certain that from that time the destiny of France was indissolubly linked with his rise and fall; upon his success or failure depended the continuance of the French entity; his plans formed the institutions of the country; his wars made French history and changed the face of the country. Aware that upon the applause of the nation rested largely the success of his ambitious projects Napoleon endeavored to obtain the good will of the public and then conform it to his wishes. Loving liberty, the French people yet gave enthusiastic support to a commander who detested liberty for any but himself; crying out for equality and fraternity they yet upheld a leader whose predominant thought was to impose his absolute will upon all others through every means at his command, and whose vision was that of absolute power. France and her conquests he used to further his own project; yet he was not insensible to the ideals of the Convention and of the Directory; on the contrary he was greatly influenced by them. His lust for conquest may partly be attributed, no doubt, to his desire for the glory of the Republic and of her ideals. These invigorating ideals of nationality and democracy he carried with him into Italy, breathing life and purpose into the beginnings of that wonderful movement which culminated in the events of 1870 and the birth of the Italian nation. From that time his master mind and subtle genius and mighty hand were the most potent factors in raising France from the pit of anarchy and degradation to the heights of pride as the most powerful nation of the world, from that time his history was French history — Napoleon was France.

The French Revolution has been characterized as «The most important event in the life of modern Europe;» it has been compared to the Reformation and to the rise of Christianity, because, as in both of these great movements, it set forces in motion which changed the thought and life of men and permanently affected human civilization. The sovereignty of the people, personal liberty, a new idea of nationality were three principles that were awankened in the minds of men. The bloodshed and treasure spent, and the unrest of Europe were but the prelude of a brighter day when order should come out of chaos, peace be restored to the nations, feudalism destroyed, social equality advanced, and great national movements made possible.

The life and work of Napoleon in the Restoration, whatever may be our judgment of his motives and his purposes, has always been a subject of profound study for the student, for there is scarcely any department of human activity that he did not touch and influence. History, religion, politics, education, law, government, political and industrial economy, and social reforms were all subjects for his wonderful energy. One of the most versatile characters of history, his reorganization of France was one of his greatest achievements.

In order to understand the conditions existing at this time and to follow the steps by which Napoleon attained his remarkable position, we must go back into the reign of Louis XVI. and study the events which resulted in the Reign of Terror, the Revolution, and the establishment of democracy.

Louis XVI., son of the Dauphin and grandson of Louis XV., ascended the throne on the death of the latter, 10 May 1774. Hardly had he been crowned when war broke out with England, in consequence of the support afforded by France to the revolted American colonies of Great Britain. A treaty of commerce and alliance with the United States was signed 6 Feb.

1778, and was followed by an immediate declaration of war by England. The war was successful in its immediate object, and was terminated by the Treaty of Versailles, 3 Sept. 1783. Three years afterward a commercial treaty was concluded with England. The first difficulty of Louis' government, however, and the rock upon which it split was the hopeless and unmanageable condition of the public finances. Maurepas, Turgot, Malesherbes, Clugny de Nuis, Necker, Joly de Fleury, d'Ormesson, Charles-Alexandre de Calonne, Loménie de Brienne and others signally failed to ward off impending disaster and resigned or were dismissed, and finally the King was forced to convoke the States-General at Versailles 5 May 1789. Owing to disputes between the three parties represented — the nobility, the clergy, and the Third Estate — the attempt to solve the difficulties was abortive. The King assumed a hostile attitude and committed several acts which angered the public, the chief of which was the dismissal of Necker who a second time had been called to the financial portfolio, and in June 1789 it became necessary to bring foreign troops to Paris to overawe the assembly. The people demanded arms and the Hotel de Ville at Paris supplied them; blood was shed there on 12 July; and on the 14th the Bastile was captured and destroyed. The *garde bourgeoise*, formed by the municipality, was now transformed into the national guard with Lafayette as commander. The spirit of insurrection in the meantime had, since the beginning of 1789, been spreading in the provinces, sections of the country were swept by a panic called the "Great Fear," and the urgency of affairs induced the assembly, on 4 August, to take a decisive step. On the basis of a future compensation all privileges were abolished. A banquet given to the foreign troops at Versailles at a time when the populace was threatened with famine excited another insurrection. Versailles was attacked by the mob, and the King brought a prisoner to Paris (5 and 6 Oct. 1789).

In December 1790, the King began to correspond secretly with foreign powers, and a secret convention had been made with Austria, Prussia, Piedmont, Spain, and Switzerland, to advance their troops to the frontiers with a view to a simultaneous occupation of the territory. Louis then made his escape from Paris (20 June 1791), and endeavored to reach Montmédy; but he was recognized on the road, arrested at Varennes, and brought back to Paris escorted by the commissaries of the assembly. A demonstration in the Champ de Mars, in favor of his deposition (17 July), was put down by force by Lafayette and Bailly, under order of the assembly.

On 30 Sept. 1791, the assembly brought its work to a finish, after having redeemed its oath of 20 June. The constitution was sworn to by the King on 14 September, after which he was reinstated in his functions. The constitution embraced all those civil reforms which, afterward incorporated in the code of Napoleon, survived the political changes of the Revolution. It deprived the King of arbitrary powers, and voted him a civil list; it provided liberty of worship, freedom of the press, of commerce, of industry; the laws of primogeniture and entail were abolished, and equal division of property among children made compulsory; confiscation of property for offences was abolished, and personal punishment substituted; titles were abolished; the clergy were reduced to public functionaries, salaried by the state; the territory of France was declared free through all its extent, and a redivision of it was effected (15 Jan. 1790) into 83 departments. This division afterward proved an admirable instrument of centralization, and in repeated emergencies enabled Napoleon at once to lay his hand with ease upon all the military resources of France. One of the measures already mentioned in particular demands further details, as it was the means of meeting the financial difficulty, and at the same time of arming the enemies of the Revolution, at whose expense it was effected. On 2 Dec. 1789, the domains of the church were, in the euphemism of the assembly, put at the disposition of the nation. The minister was authorized to sell these estates to the extent of 400,000,000 livres. Until the sale was effected he was authorized on the security of these national domains to issue a paper money having a forced circulation and a preference in the purchase of them. In 1792 the estates of the emigrants were confiscated in like manner. Thus was created that seemingly inexhaustible treasury of assignats which brought France so speedily into a financial anarchy worse than any she had yet experienced. Among other reforms was the reorganization of the administration of justice. The parliaments were dissolved by indefinite prorogation, and judicial functions were separated from the administrative, district courts were created and judges appointed for 10 years. The assembly closed with an attempt to recall the émigrés, and it prohibited the reelection of its members. Mirabeau, the greatest orator of the assembly, and one of the boldest leaders of the Revolution, had died prematurely 2 April 1791, from the excesses of his life. The constituent assembly was, according to the constitution, immediately followed by the legislative assembly, which began its sittings on 1 October, but before the period assigned by the constitution it gave place to the convention. In the legislative assembly there were two parties of political importance, the Girondists, who led it, and the Montagnards, who subsequently became all-powerful in the convention. The royalists were already powerless. The assembly was compelled at once to take a decisive course. By the declaration of Pilnitz the Emperor of Germany and the King of Prussia threatened an armed intervention to restore Louis to his rights. The King was compelled in March to accept a Girondist ministry, and on 20 April 1792, war was declared against the empire. The first attempts to assume the offensive were unsuccessful, and the French armies were not even able to prevent the enemy from invading home territory. To make matters worse the King maintained a treasonable correspondence with the allies and refused to sanction the decrees of the assembly. Paris grew restless as the enemy advanced; unscrupulous politicians urged the mobs to violence and on 20 June, the people invaded the assembly and the Tuileries, and summoned the King to sign the decrees. He refused, but satisfied them for the moment by allowing himself to be crowned with a red bonnet. On 26 July the Duke of Brunswick issued his celebrated and impolitic manifesto, threatening, if the King were insulted, to deliver Paris to a military execution. The sections of Paris retorted by signing a petition demanding the deposition of the King before the close of the day (9 August). At midnight the tocsin sounded. The Tuileries, after a sanguinary combat, were taken and sacked. The King took refuge with his family in the assembly, which was invaded and compelled to submit to the dictation of the victors by assenting to the suspension of the King and the convocation of a national convention. The convention was an extraordinary assembly, summoned for an emergency, and thus recognized the fact that France was again without a constitution. The war now assumed a more favorable aspect. The victory of Valmy, 20 Sept. 1792, caused the Germans to fall back discomfited; the siege of Thionville was abandoned; and France was freed of her invaders. Savoy, Nice, and Villafranca were seized and occupied by the French; the army of Alsace under Custine took Speier (30 Sept. 1792), Worms (5 October), and Mainz (21 October); Frankfort capitulated to Houchard; and the victory of Dumouriez over the Austrians at Jemappes, 6 Nov. 1792, led to the occupation of Belgium.

The first act of the new assembly, 21 Sept. 1792, was to proclaim the republic. Thus the Year I of the republic began. On 3 December the King was cited to appear before the assembly. On 20 Jan. 1793, he was, by four successive votes, sentenced to death within 24 hours, and on the 21st the sentence was executed. This violent inauguration of the republic shocked public opinion throughout Europe, and armed the neutral states against France. England, Holland, Spain, and the empire joined the coalition. A levy of 300,000 men was ordered. It was necessary to send some of these new levies to suppress the Chouan insurrection in Mainz, Anjou, and Brittany. Nearly all the officers of rank had emigrated, and Dumouriez feeling that hostility was rising against him in Paris resolved to regain his prestige by a bold stroke — the conquest of Holland. He was defeated in the attempt, however, by the Prince of Coburg who administered a crushing defeat at Neerwinden, 18 March 1793. Dumouriez then secretly agreed to evacuate Belgium and turning against the convention deserted to the allies on 4 April. Mainz was also lost by Custine. At home the army lost confidence in its heads and became disorganized. Mutual suspicion and distrust reigned in the convention itself. The convention took measures suited to the gloomy aspect of affairs. A revolutionary tribunal was appointed to try offences against the state, a committee of public safety, with sovereign authority, was appointed (6 April), and the convention renounced the inviolability of its members. The period thus inaugurated is known in history as the Reign of Terror. The struggle between the Girondists and the Montagnards became violent. The latter, defeated in the convention, armed the sections of Paris. The convention, under pressure, ordered the arrest of 31 Girondists (2 June). Some of them escaped and excited insurrection in the provinces. A new constitution was adopted by the convention 23 June, called the Constitution of the Year I, the Republican Calendar being adopted on 5 Oct. 1793. The energy of the dominant party had risen to the danger, but it was accompanied by a ferocity without example. The revolutionary tribunal had already filled the prisons with victims. On 10 Oct. 1793 the constitution was suspended and the government declared revolutionary, a term which included unlimited power. Both in Paris and the provinces executions and massacres followed each other daily, and as new parties succeeded each other in the convention the leaders of the defeated parties were added to the usual list of suspected royalists or reactionaries. Thousands of paid committees were formed throughout France. The Queen was executed on 16 Oct. 1793; the Girondists (against whom public anger had been more deeply aroused by the assassination of Marat on 13 July by Charlotte Corday) on 31 October (10th Brumaire) the Hébertists on 24 March 1794, the Dantonists on 5 April. Robespierre had a new law passed on 22 Prairial (10 June) to facilitate these executions, and from this date to 27 July about 1,400 persons are supposed to have perished. At length the Reign of Terror came to an end by the revolution of the 9th Thermidor and by the execution of Robespierre and his associates on 27 and 28 July 1794.

In the meantime the majority of the southern towns declared against the convention, the French territory was invaded both on the north and south and to all these dangers was added famine. Condé was taken by the allies 12 July 1793; Mainz surrendered 23 July; and Coburg took Valenciennes on the 28th. The convention fixed a maximum price for the sale of provisions. A decree was passed excluding English manufactures from France. A levy was ordered of 1,200,000 men, and Carnot organized 14 armies. The revolted provinces were speedily reduced. At this time Napoleon first became prominent in France. In September 1793 he was commissioned lieutenant-colonel of artillery and sent to Toulon to assist in the reduction of that city which was then in the hands of the English. By his strategy this was accomplished on 19 December, and Jourdan, in the north, was enabled to give his undivided attention toward driving the principal forces of the coalition from the country. During the balance of 1793 and in 1794 the campaigns resulted favorably to the French arms. Jourdan defeated the Prince of Coburg at Wattignies 15 and 16 Oct. 1793. Hoche, after losing the three-day battle of Kaislerlautern (28 Nov.–1 Dec.) and winning the battle of Wissenberg (26 December), wintered in the Palatinate. In Italy and Spain the French had also been able to carry the war beyond their own frontiers. In the spring of 1794 the French armies took the offensive. An attack on Lille by Coburg's forces was repulsed with great loss on 18 May; Jourdan crowned a series of victories by the capture of Charleroi in June; and by the victory of Fleurus (26 June 1794) recovered Belgium, and Pichegru by the beginning of 1795 had completed the conquest of Holland. A treaty of peace was signed 16 May. Holland, under French influence, constituted itself into the Batavian Republic. Tuscany concluded peace with France 9 February. By the successes of Jourdan the allies were driven across the Rhine, and Spain was invaded. These successes induced Prussia and Spain to lay down their arms. By the treaties of Basel (q.v.) signed by the former on 5 April, by the latter on 12 July (ratified 22) 1795, and by Hesse-Cassel on 28 August, these countries acknowledged the French Republic (See PEACE TREATIES). The English during this time had been successful at sea and had made extensive captures among the French colonies. Meanwhile (in February 1794) Napoleon had been promoted to the rank of brigadier-general of artillery and later in the same year was sent to Genoa to study its defences and the political disposition of its inhabitants.

In 1795 the convention gave the republic a new constitution called the «Constitution of the Year III,» a chamber of Five Hundred to propose the laws, a chamber of Ancients to approve them, an executive of five members, one elected annually, called the directory. This tame bequest of that once terrible assembly marked the progress of a strong reaction. The royalists conceived sanguine hopes of a restoration. Pichegru was gained, a royalist insurrection organized, and 30,000 men marched on the Tuileries, where the convention sat. Barras intrusted the defence to Napoleon who had lately returned. He with 5,000 men and his artillery, though he had only a single night in which to prepare, not only repulsed the insurgents but poured such murderous discharges of grape into their ranks that within an hour after actual fighting began he had secured victory for the convention. This event is called the affair of the 13th Vendémiaire (5 Oct. 1795). In recognition of his services Napoleon was now appointed by the convention to the command of the army of the interior. The convention was dissolved on 26 October.

With the suppression of the revolution at Paris by Napoleon, the subjugation of the Vendeans and Bretons by Hoche, the crushing of the «Conspiracy of Babeuf,» and the pacification of the other sections of the country, came a distinct lull in political passion. For the first time in many years the armies of France were idle and so the directory planned further foreign conquests. Carnot, the «organizer of victory,» who was one of the five members of the directory, was depended upon for the military success of the campaigns. He planned an attack on Austria and resolved to strike from three separate points. In 1796 he sent out three armies which were to hem in the Austrians on all sides and descend upon Vienna simultaneously. Two of these armies, each 70,000 to 80,000 strong, were to enter Germany to reach the valley of the Danube, one under Jourdan — the army of the Sambre and Meuse — by way of the valley of the Main, the other under Moreau — the army of the Rhine and Moselle — by way of the valley of the Neckar, both then to descend upon Austria. Napoleon with the third army — the army of Italy — 40,000 strong, was to menace Italy. Let us follow this last army.

One object of the campaign was to make the armies live on foreign territories. Bonaparte's lieutenants in Italy were already experienced generals. He assembled them and unfolded his plans, which silenced the jealousy naturally caused by his appointment. To the soldiers he issued the first of his rousing proclamations: «You are ill-fed,» he said, «and almost naked; the government owes you much, and can give you nothing. I am about to lead you to the most fertile plains in the world, and to opulent cities where you will find honor, glory, and riches.» During four years the army had been struggling against the Sardinian and Austrian troops, without decisive success, on the southern slopes of the Alps and Apennines. The Sardinians stretched from the Bormida to the Stura, with an entrenched camp at Ceva. The Austrians were cantoned in the neighborhood of Alessandria and Tortona, commanding the roads to Genoa and Milan. Napoleon threatened an attack on Genoa by Voltri, but made his real advance through the valley of the Bormida. Toward the end of March 1796 he set out from Nice and after defeating the allies at Montenotte (11 April) seized that town and thus placed himself in their centre. Having first repulsed the Austrians he pursued the Sardinian army, beat it at Millesimo (13–14 April) and at Mondovi (22d), and drove them before him to Cherasco, where an armistice was concluded (28 April), which was converted, on 15 May, into a definite treaty, by which Sardinia renounced the coalition and ceded Savoy and Nice to France. In the interim Napoleon sent Masséna and La Harpe against the Austrian army and they defeated it at Dego, 14–15 April. Napoleon then by forced marches to Piacenza compelled Beaulieu to retreat toward the Tyrol. He crossed the Po at Piacenza, stormed the Bridge of Lodi (10 May) which was held by the Austrians to cover their retreat, and entered Milan on 15 May. Brescia was entered on the 28th, the passage of the Mincio forced at Borghetto on the 30th; and the Austrians, after garrisoning Mantua, retired into the Tyrol. The English were dislodged from Leghorn and Corsica; and Venice, Genoa, and Piedmont gave in.

Napoleon followed up his successes by negotiations with the Italian princes and the Pope, upon whom he levied contributions. The King of Naples signed an armistice on 5 June. Besides money, so much wanted by the directory, Napoleon provided a pleasing tribute to French vanity by stipulating for the surrender of pictures, manuscripts, and works of art. On Lombardy he levied a contribution of $400,000,000; the Pope promised $420,000,000. He sent $200,000,000 to the directory, which had not been able to defray the expenses of his campaign. While he besieged Mantua, a fresh army of Austrians under Wurmser advanced against him in three divisions. Here Napoleon's ability to grasp a situation quickly and to discover the critical point in a campaign were remarkably displayed and served him well. He raised the siege of Mantua, beat one division under Quosdanovich at Salo and Lonato, 3 Aug. 1796 and another under Wurmser at Castiglione, on the 5th. Wurmser, reinforced to 50,000 men, again attempted to relieve Mantua. Napoleon, who had entered the Tyrol and had reached Trent on his way to Innsbrück, after defeating 25,000 Austrians under Davidovich at Roveredo, on 4 September and winning the battle of Calliano, descended the valley of the Brenta after Wurmser, defeated him at Bassano (8 September) at La Favorita and at Saint George and about the middle of that month shut him into Mantua.

On the other hand the same success had not attended the armies of the north. The Archduke Charles had defeated Jourdan, and forced Moreau, who had penetrated into Bavaria, to retreat by the Black Forest to Alsace which he reached in October. Thus any relief for Napoleon was checked. At this time also a great expedition to Ireland under Hoche failed and that general was recalled to France to serve with one of the other armies. These events enabled the Austrians to send a fresh army after Napoleon, consisting of 50,000 men, under Alvinczy and Davidovich. In vain, however. After sustaining repulses at Rivoli and Caldiero, he outmanœuvred Alvinczy and defeated him at Arcola 15–17 November. In January 1797 Alvinczy, with large reinforcements, again advanced from Roveredo to the relief of Mantua. The French were driven in at La Carona but Napoleon defeated him on the 14th at Rivoli and on 2 February received the surrender of Mantua from Wurmser. On the same day he put an end to his armistice with the Pope and invaded the States of the Church, defeating the papal troops at Senio, and in rapid succession capturing Faenza, Ancona, Loretto, and Tolentino. A speedy understanding was come to by the Treaty of Tolentino (19 Feb. 1707); the Pope surrendered Avignon, Bologna, Ferrara, and the Romagna to France; these were added to the provinces of Modena and Reggio, taken from the Duke, and formed the Cispadane Republic, as, after the battle of Lodi, Lombardy had been proclaimed as the Transpadane Republic.

The Austrians, however, were preparing for another invasion of Italy under the Archduke Charles, and Napoleon resolved to anticipate them before they should receive their reinforcements from the armies on the Rhine. He therefore entered the Tyrol, driving the Archduke before him, and, crossing the Noric Alps and penetrating as far as Leoben in Styria, he had reached Judenburg, a few days' march from Vienna, when an armistice was accepted (7 April 1797) and preliminaries were signed at Leoben on the 18th, ceding the Austrian Netherlands and Lombardy to France, and indemnifying Austria with Venetia. These preliminaries were confirmed by the Treaty of Campo Formio, signed 17 October. While Napoleon was carrying on these stupendous operations, Hoche and Moreau had conducted equally glorious but less successful campaigns against the Austrians in southern Germany and had pushed them back into the Black Forest when they received the news from Leoben and suspended active operations.

In the meantime the condition of affairs at home was becoming worse. The Reign of Terror had been followed by an excessive dissolution of manners. Brigandage prevailed in the provinces. Barras, a member of the directory, and other high officials, had been guilty of malversation and private jobbing in the public funds. The returned royalists were intriguing for a counter-revolution. The reactionary party had triumphed in the elections of May 1797, and had succeeded in electing Pichegru president of the Five Hundred, and Barbé Marbois, another royalist, president of the Ancients, and had replaced Letournerre in the directory by Barthélemy. The majority of the directory, relying on the support of Bonaparte, resolved to anticipate them. Hoche had been recalled with his army from the Rhine and from Italy Napoleon sent Augereau, his trustworthy aide, and with these the directory carried out the *coup d'état* of the 18th Fructidor (4 Sept. 1797). On that night Augereau introduced 12,000 men into Paris, surrounded the halls of the councils, and arrested the leaders of the reactionary party. The minorities of the two councils, assembled on the invitation of the directors, condemned 53 deputies to transportation; annulled the elections in 48 departments, and repealed the laws which had been passed in favor of priests and emigrants; and other violent measures were also taken. Moreau, who had betrayed the intrigues of Pichegru, was himself suspected, and deprived of his command; and Hoche in consequence received command of the two armies of the Rhine. Soon afterward, however, he was taken suddenly ill (some say he was poisoned) and died.

It seems to have been the purpose of the directory at this time to invade England and with this object in view a large army had been gathered together. Napoleon was placed in command of it and though at first he professed to favor the design, he readily saw its impracticability and finally persuaded the directory to abandon the project. As an alternative he proposed to ruin the English Indian empire by the conquest of Egypt. His plan was approved; an army consisting of 36,000 men was equipped; and in a fleet commanded by Brueis the expedition embarked at Toulon on 19 May 1798. In passing they took Malta from the Knights 9–10 June. The fleet a few days later set sail for Egypt and reached Alexandria 1 July. Napoleon sent Kléber forward to take that city and then advanced on Cairo but before he reached his destination he encountered a large force of Mamelukes. A long and bloody struggle ensued known as the battle of the Pyramids, but on 21 July Napoleon emerged victorious. He then entered Cairo in triumph. Napoleon thinking himself secure set about reorganizing the civil and military government of the country, among other things establishing on 22 August the Institute of Egypt; but before he had accomplished much in that direction fortune delivered a terrible blow. While he was thus occupied in the interior, Nelson, in command of the English fleet, had pursued the French fleet, found it moored in the Bay of Abukir, defeated and nearly destroyed it in what is called the battle of the Nile, 1–2 Aug. 1798. The French were thus cut off from escape. To make matters worse the Sultan declared war against Napoleon. Beside this in October the people in Cairo revolted and then occurred the fearful massacres when 2,000 people were put to death. Napoleon, however, instead of attempting to return to France resolved to conquer Syria. Early in February 1799 he started with 13,000 men to cross the desert. El-Arish.

Gaza, and Jaffa quickly succumbed and he then laid siege to the city of Acre which was defended by a Turkish garrison under Djezzar Pasha, assisted by the English commodore Sir Sydney Smith. It was probably at this time that he heard of the disorders in France and the disasters to French armies. This fact combined with his inability to capture the city undoubtedly influenced his decision to return to France. He therefore on 20–21 May, after a 60-day siege, relinquished the attempt to capture the place and returned to Egypt, laying waste the country by fire and having lost over 4,000 men in the expedition. Napoleon re-entered Cairo on 14 June but not a month had passed before it was announced that a Turkish expedition of 10,000 men was marching against him. On 25 July Napoleon attacked and almost annihilated this force, which the Sultan had landed at Abukir. On 22 Aug. 1799 he transferred the command of the Egyptian army to Kléber and embarking in a frigate landed at Fréjus 9 October after several narrow escapes from capture by the English Mediterranean cruisers.

While Napoleon was conducting these operations in Egypt a second coalition in violation of the Treaty of Campo Formio had been formed against France, embracing England, Russia, Austria, and other German states, Naples, Portugal, and Turkey. To meet this danger the councils passed the law of the conscription (5 Sept. 1798), and ordered a levy of 200,000 men. The campaign of 1799 was disastrous to the French. Jourdan, who had crossed the Black Forest, was defeated by the Archduke Charles at Stockbach in Swabia on 25 March, and forced to retire beyond the Rhine. Schérer, who was intrusted with the command of the army of Italy, was defeated at Magnano on 5 April. Moreau, who superseded him, sustained further reverses; and MacDonald, who came to his assistance with the army of Naples, was totally defeated in the battle of the Trebbia, 17–19 June, Turin, Alessandria, and Mantua were captured. Joubert, who succeeded Moreau, was defeated and killed at Novi 15 August. On the other hand, the Anglo-Russian campaign in Holland failed; and Masséna, after a brilliant campaign in Switzerland, defeated the Russians and Austrians at Zurich on 25 September, which induced the Emperor Paul I. to make peace.

Napoleon, on his return, found the government in great embarrassment. Its credit was wholly gone. It was obliged to fund the interest of its debts or pay it in worthless paper money. It was ill-obeyed by its generals. A revolution had taken place in the government (18 June), but the new directors were as incompetent as the old. In these circumstances was accomplished the revolution of the 18th and 19th Brumaire (9–10 Nov. 1799) by which the directory was abolished. The councils being alarmed with rumors of a Jacobin plot, the Ancients gave orders that both bodies of the legislature should be transferred to Saint Cloud under the conduct of Bonaparte, who was intrusted with the command of the troops. Bonaparte had already secured the co-operation of Moreau and the other generals present in Paris. On the 10th Napoleon entered the Council of the Ancients assembled at Saint Cloud, and insisted on the necessity of a new constitution. On proceeding to the Council of the Five Hundred he was received with cries of *à bas le dictateur*. Gen. Leclerc, by his orders, entered and dispersed the assembly. The members of the two councils who were favorable to Bonaparte then appointed a provisional government of three consuls — Bonaparte, Siéyès, and Roger Ducos, and a committee consisting of 25 members, of each council to draw up a new constitution, which was proclaimed on 15 December, and called the "Constitution of the Year III." The three consuls were appointed for 10 years, and re-eligible. The first had all the executive powers, the others only a consultative voice. This constitution was submitted to the approbation of the people, and accepted by 3,011,107 suffrages against 1,567. The departments were put under prefects directly responsible to the minister of the interior. The prefects, subprefects, and maires of communes had their councils, which were merely consultative, the whole executive power being in the hands of the officer responsible to government.

Bonaparte chose Cambacérès and Le Brun as second and third consuls. He then undertook the task of reforming civil affairs. He recruited the national treasury, repealed many of the more violent laws that had been promulgated during the Revolution, and reopened the churches. He wrote letters to the King of England and the Emperor urging, in theatrical terms, the restoration of peace, but these overtures were refused, and his next business was to prepare for war. He gave Moreau the command of the army of the Rhine, and determined himself to proceed to Italy. Masséna, with the remains of the French army, was shut up in Genoa. On 13 May 1800 he began his memorable march across the Alps and on 2 June to the surprise and consternation of the allies entered Milan. After several unimportant skirmishes he attacked and decisively defeated the Austrians at Marengo on 14 June 1800. He thus for a second time secured to the French possession of all the Piedmontese fortresses. By the Convention of Alessandria, signed on the 16th, Melas abandoned all Piedmont and Lombardy to the Oglio. Napoleon then committed the command to Masséna and returned to Paris. Meanwhile Moreau defeated the Austrians in several engagements during May, and forced them to take refuge in Ulm. For a while Napoleon's time was divided between campaigning and negotiating. The English, however, finally persuaded the Austrians to continue the struggle and late in the year hostilities once more began in the valley of the Upper Danube. Moreau again defeated the Austrians under the Archduke John on 3 December in the important battle of Hohenlinden and after a series of brilliant combats drove the Austrians back till Vienna was in terror. Brune, who succeeded Masséna, extended the Italian conquests in Tuscany and Venetia. Negotiations were then entered on by Austria, and the Peace of Lunéville concluded 9 Feb. 1801. The Rhine was recognized as the boundary between France and Germany. The Adige was to be the boundary of Austria and Italy. The independence of the Batavian, Helvetian, Cisalpine, and Ligurian republics was guaranteed. A treaty was also concluded with Spain at Madrid on 21 March; and by the Treaty of Florence, 28 March, Naples agreed to renounce the coalition, and received French garrisons. Treaties were also signed with the Pope, Bavaria, Portugal, Russia, and Turkey. Russia, Prussia, Denmark, and Sweden then formed an armed neutrality in opposition to the naval privileges claimed by England, which now maintained the war single-handed. This led to a brief war between England and the northern powers, except Prussia, which was terminated by the death of Paul I., and the battle of Copenhagen.

During all this time, the French army in Egypt, though greatly weakened, was unsubdued. On 8 March 1801 an English fleet under Abercrombie debarked 18,000 troops at Abukir; on 13 March this force attacked and defeated the French; on the 17th Sir Sydney Smith reduced the forts at Abukir; and on the 20th 15,000 English again attacked 9,000 French and forced them back to Alexandria and Cairo. Gen. Kléber had been assassinated and so on 30 August Gen. Menou, by a capitulation with the English, agreed to evacuate Egypt. Both England and France were now anxious for peace. Preliminaries were signed on 1 October and the Peace of Amiens was concluded 27 March 1802. France retained her continental conquests. Ceylon was ceded to England by Holland, and Trinidad by Spain; all the other conquests of Great Britain were restored. Malta, which had been taken by the English, was to be restored to the Knights of Saint John. This lull in active warfare allowed Napoleon time to crush an insurrection of the blacks in Santo Domingo.

Napoleon exhibited his wonted vigor in home administration. By means of the senate he silenced the opposition of the tribunate and the corps législatif. He assembled the most noted lawyers in France under the presidency of Cambacérès to draw up a new code of civil laws now known as the «Code Napoleon» (see CODE). He entered into a concordat with Cardinal Consalvi for the re-establishment of the Catholic religion. He undertook public works, constructed roads and bridges, encouraged industry and commerce. On 2 Aug. 1802, Napoleon and his colleagues were made consuls for life.

The external policy of Napoleon was not calculated to conciliate the jealousies caused by the extension of French dominion. The independence of the new republics was merely nominal. The island of Elba was occupied and incorporated with France in August 1802, Piedmont 11 September, and Parma in October; while in the same year Piacenza was united to the country and an armed intervention changed the government of Switzerland. Holland was also treated as a part of France and received a constitution from Paris. By the Treaty of Lunéville the German princes dispossessed by the advance of the French boundary were to be indemnified beyond the Rhine. The process of compensation was not carried out with sufficient promptitude for Napoleon. By his interference, in conjunction with that of the Emperor of Russia, the indemnification was effected by the extinction of the two electorates of Cologne and Trèves, and the secularization of the ecclesiastical estates. Napoleon on 30 April 1803 sold Louisiana to the United States for $15,000,000.

The discontent excited in England by this aggressive policy made it evident that the peace could not be maintained, and the government refused to evacuate Malta. On 16 May 1803, two days before the declaration of war, an embargo was laid on all French and Dutch vessels in English harbors. Napoleon retaliated for this lawless proceeding by seizing as hostages all English travelers in France and Holland, and Gen. Mortier took military possession of Hanover. Russia and Prussia attempted to intervene, but on terms unacceptable to France. Spain and Portugal had to purchase their neutrality from France; but as this purchased neutrality placed the former at the disposal of France, England declared war with Spain. Naples was occupied by French troops, and vast preparations were made ostensibly for the invasion of England. While these events were occurring a conspiracy for the overthrow of Bonaparte and the restoration of the Bourbons was discovered in 1804, in which the British government was implicated. The most distinguished of the conspirators were Cadoudal, Pichegru, and Moreau. Cadoudal was executed, Pichegru destroyed himself in prison, Moreau was pardoned, and retired to the United States.

The legislative bodies were now completely subservient to Napoleon, and the conspiracy of Cadoudal was made a pretext for offering him the empire. The *senatus-consultum* for the regulation of the empire, drawn up by Napoleon himself, was passed 18 May 1804. The empire was confirmed by a popular vote of 3,572,329 against 2,569. The coronation took place at Notre Dame on 2 Dec. 1804, and the empire was established.

Bibliography.— There are numerous and excellent histories of France and other general histories which cover this period both in outline and in detail. Among them are: Lavisse and Rambaud, ‹Histoire Générale› (12 vols., Paris 1893–1901); Fleury, ‹Histoire de France› (1891); G. W. Kitchin, ‹History of France to 1793› (3 vols., Oxford 1882); Crowe, ‹History of France› (5 vols., London 1858); Mackenzie, ‹The Nineteenth Century› (London 1882); Guizot, ‹Histoire de France› (Paris 1870); Duruy, ‹Histoire de France› (trans. by Carey, New York 1889); Martin, ‹Histoire de France› (Paris 1855–60); White, ‹History of France› (1890); Yonge, ‹Three Centuries of Modern History› (London 1872); Edwin Emerson, Jr., ‹A History of the Nineteenth Century Year by Year› (New York 1901); Thornton's, ‹Continental Rulers› and Oscar Browning's ‹Wars and Military Development› in vols. VI. and XVII. respectively of ‹The Nineteenth Century› (Toronto and London 1902); also for the institutions consult Taine's ‹Modern Régime› (Paris 1891–4; trans. by Durand, New York 1894). The ‹Cambridge Modern History› (Vol. VIII. ‹The Revolution› and Vol. IX. ‹Napoleon,› Cambridge 1904–6), beside treating the history of this period in detail cites an enormous number of works, original documents, etc., on each period and on every phase of the subject which the student may consult with profit.

4. **France — The Empire.** As the fear of socialism helped to found the consulate in 1799, so the royalist plot of 1804 precipitated the foundation of the Empire. Much as France abhorred the execution of the Duc d'Enghein, she was still more aghast at the prospect of the turmoils which would ensue, should Napoleon be suddenly removed from the head of affairs. "The need of repose and stability," says Miot de Melito, "was so pressing, the future so disquieting, the fear of terrorism so great, the return of the Bourbons so formidable that people quickly grabbed at any expedient which might save them from those dangers." Seven days after the Duke's murder, Fouché appealed to the Senate to establish hereditary government. The idea was taken up on every side. Carnot alone opposed it in the Tribunate; the Senate, the Council of state, reported in its favor and after a brief period of affected hesitation Napoleon complied with the general desire. On 18 May 1804, a constitution which had been elaborated by Fouché and Talleyrand was adopted in the Senate with three dissentent voices. It decreed to Napoleon the title of Emperor of the French and settled the succession to the throne on his direct male issue, natural and legitimate. It enabled a childless emperor to adopt the children or grandchildren of his brothers, and designated Joseph and Louis Bonaparte (Napoleon's brothers) to the succession, in case the Emperor should die without natural or adopted children. The civil list was fixed at 25,000,000 francs, a sum established in the constitution of 1791; and other provisions were added with the design of adding brilliance and authority to the throne. Six grand dignitaries of the Empire, irresponsible, irremovable, enjoying the status and prerogatives of princes, were to support the new Emperor. Cambacérès was made Archchancellor, Lebrun, Archtreasurer. The office of Grand-Elector — a title borrowed from the nomenclature of the Holy Roman Empire — was conferred on Napoleon's elder brother Joseph; the office of Constable was given to the younger brother Louis. The remaining two dignities were ultimately conferred upon connections by marriage, and while Napoleon's stepson, Eugène Beauharnais, became Archchancellor of State, his brother-in-law, Murat, was given the rank of High Admiral. Another provision in the Senate's constitution of 18 May 1804, was designed to conciliate the army. There were to be 16 marshals of the Empire, and the marshal's bâton henceforward became the chief prize of military ambition. At the same time the court was furnished with decorative officials, with a grand almoner (Cardinal Fesch), a grand marshal of the palace (Duroc), a grand chamberlain (Talleyrand), a grand equerry (Caulaincourt), a grand master of ceremonies (De Ségur), and with numerous prefects and ladies of the palace. The changes made in the mechanism of the government were even more significant of absolutist tendencies. The restriction placed upon the numbers of Senators was removed and their nomination conferred upon the Emperor. The Tribunate was divided into three sections, dealing respectively with legislation, home affairs, and finance; a measure which effectually destroyed its potency as an organ of protest; and though the legislative body was given the power of discussing measures in a general committee, the discussions, unless invited by the Council, were neither to be published nor printed. As a matter of fact both Tribunate and Legislative ceased to be working parts of the machinery. As the powers of the Tribunes expired, no fresh nominations were made, and so the body vanished from the constitution. A more expeditious method of legislation was discovered. The Emperor governed by means of *Senatus Consulta* or decrees of the Council of State.

The French people acclaimed the constitutional revolution by more than three and a half million votes; that is to say, by a larger majority than was given for the Consulate or the Consulate for Life. Of the opponents, Carnot was the most conspicuous; and it is noticeable that almost all the barristers of Paris were against the establishment of monarchy; but the army was flattered by the elevation of its leader, and the peasantry saw in the change a fresh guarantee for the stability of the revolutionary land settlement. That he might reassure the Catholics, and win the royalists, Napoleon summoned the Pope to preside over the coronation. Pius VII. undertook the journey, but was destined to receive a lesson upon the relations of the spiritual to the temporal power. After he had anointed the Emperor and Empress with the holy oil and as he was proceeding to perform the act of coronation, Napoleon seized the crown and placed it on his head with his own hands. The sword and insignia of Charlemagne were brought from Aix to give significance to the occasion, as if the ceremony of Notre Dame betokened nothing less than a revival of the great Frankish empire.

Meanwhile war had broken out with England. The vigilance of the English fleet prevented that concentration of the French navy in the channel which was essential to the escort of the Boulogne flotilla, but Napoleon had paved the way for a war with Austria, in case it should prove impossible to strike at London. On the pretext that an emperor could not also be president of a republic, it was determined to convert the Italian republic into a monarchy. The Italian crown was offered first to Joseph, then to Louis, but the brothers were too ambitious to renounce their claims on the imperial succession, and Napoleon finally decided to assume the crown himself and to appoint Eugène Beauharnais his viceroy. Italian deputies were summoned to Paris to vote the crown and in May 1805 Napoleon went to Italy to receive it. In the cathedral of Milan on 26 May he placed the old iron circle of the Lombard Kings upon his brow, and though the French Senate and the rulers of Europe were assured that the Italian Kingdom and the French Empire would be kept strictly separate, no one was deceived. The annexation of Genoa to France was a proof that Napoleon's ambition was insatiable, and advertised to the powers that war was the only remedy. By July 1805 Russia had determined to break off relations with Napoleon; on 9 Aug. Austria gave her secret adhesion to the Russo-British alliance, by the middle of September an Austrian army under General Mack was at Ulm. The speed and genius of Napoleon disconcerted all the calculations of his enemies. The army of England (rechristened 29 Aug. the grand army) was swung round, and rapidly pushed through Germany into the valley of the Danube. On 20 Oct. Mack, surprised, surrounded, and overwhelmed, capitulated at Ulm; and on 2 Dec. (the anniversary of the coronation) the Austrians and Russians were defeated with huge loss at Austerlitz. Francis withdrew from the war and on 20 Dec. 1805, signed the treaty of Pressburg with France.

The most obvious political result of the campaign was that the influence of the French Empire was substituted for that of Austria in Italy and Germany. The Hapsburgs were compelled to recognize the Italian Kingdom and the annexation of Genoa, and to cede Venetia, Istria, and Dalmatia to the victor. The Neapolitan Bourbons had received an Anglo-Russian force into their capital, and for this violation of neutrality they were condemned to expulsion. Accordingly no sooner had peace been struck at Pressburg than Napoleon sent St. Cyr (q.v.) and Massena (q.v.) to expel «the guilty woman» who had so flagrantly «violated all that is sacred among men.» In this mission they were successful. On 13 Jan. 1806, Ferdinand and Caroline fled to Sicily, where they were secured by the protection of the English fleet. The Kingdom of the two Sicilies was given to Joseph. Elise Bacciocchi, a sister of Napoleon, became Princess of Lucca and Piombino, while another sister, the beautiful Pauline Borghese, received the principality of Guastalla. Thus the whole of the Italian peninsula, save the Papal States, came under French control.

The results of Austerlitz were no less impressive in Germany. Before the war Napoleon had solicited and obtained the alliance of the South German dynasties and after the victory he proceeded to reward his allies. Bavaria and Wurtemburg were raised to the dignity of kingdoms; Baden became a grand duchy, while marriages were arranged between Eugène and Princess Augusta of Bavaria, Jerome and Princess Caroline of Wurtemburg and Stephanie de Beauharnais and the Crown Prince of Baden. By recognizing the independent authority of the three South German Princes Napoleon had practically eliminated Austrian influence from South Germany, but so long as the shadow of the Holy Roman Empire remained, the Hapsburgs still retained a right of intervention in German affairs. This right Napoleon determined to abolish. On 1 Aug. 1806, the Diet of Ratisbon was informed that the Holy Roman Empire was at an end. In place of this ancient and picturesque institution a confederation of the Rhine was formed under the protectorate of Napoleon, a «new Carolingian code» as it was called in Paris, where it was drafted under the direction of Talleyrand. The 16 princes who joined the confederation were bound by a close offensive and defensive alliance to France and compelled to furnish contingents to the grand army. As the price of their subservience to the Protector of the League, they were encouraged to be autocratic in their own dominions.

As Austerlitz gave Napoleon control of Southern Germany, so Jena and Friedland made him master of the north. The Prussian Court, roused by the occupation of Hanover in 1803, the murder of the Duc d'Enghein in 1804, and the violation of Prussian neutrality by Bernadotte's corps in 1805, determined (October 1805) to present an ultimatum to Napoleon and in the event of his refusal to cast in her lot with the allies. But the battle of Austerlitz intervened, and Haugwitz, the bearer of the Prussian ultimatum, was compelled to sign the humiliating treaty of Schönbrunn (15 Dec. 1805), the main object of which was to involve Prussia in war with England by forcing her to accept Hanover. But the war spirit was now high in Berlin, and everything in Napoleon's conduct during the ensuing months — the formation of the Confederation of the Rhine, the obstacles placed in the way of a counterbalancing confederation of the North — was calculated to raise it. Finally Prussia learned that Napoleon was offering Hanover to England, and rushed into war. Napoleon, swiftly marching through the depths of Thuringia, beat the Prussians at Jena and Auerstadt, 14 Oct. 1806, occupied Berlin, compelled the Saxons to enter the confederation of the Rhine, and finally, after the bloody and indecisive battle of Eylau, 6 Feb. 1807, won a crowning victory at Friedland, 14 June, which led Alexander of Russia to decide for peace. The three sovereigns met at Tilsit, and then a peace was signed 7 July 1807. Prussia was not only compelled to pay a heavy war indemnity, and to support a French army of occupation, but was stripped both of her eastern and western provinces. The provinces (save the circle of Bialystock) acquired by the second and third partition of Poland, were formed into a grand duchy of Warsaw, which was attached to the Saxon kingdom, and consequently included in the Rhenish confederation. On the western frontier, the Westphalian province, including the important fortress of Magdeburg were, together with the Duchy of Brunswick, parts of Hanover and the electorate of Hesse-Cassel, formed into a kingdom of Westphalia for Prince Jerome, the youngest brother of the Emperor, likewise included in the Rhenish confederation. The Baltic littoral passed under French control, for, though Danzig was proclaimed a free city, it was to be governed by a French force, and though the Duchies of Oldenburg and Mecklenburg-Schwerin were restored to their respective dukes, they were to sustain a French army of occupation until the general peace. Meanwhile, on 21 Nov. 1806, Napoleon had issued the famous Berlin decrees (q.v.), the object of which was to ruin England by excluding her goods from the continent, and by declaring the British isles to be in a state of blockade. But to make the continental blockade completely effective it was necessary to control all the littoral of continental Europe; and this, accordingly, became the primary aim of imperial policy. The Batavian Republic was converted into a kingdom of Holland, and placed under the control of Louis in 1806, while the refusal of the Pope to accede to the blockade led to the gradual absorption of the Papal States, and to their final incorporation in the French Empire in 1809. This, too, was the primary motive for Napoleon's intervention in the affairs of the Iberian peninsula. While returning from Tilsit, Napoleon commanded Talleyrand to inform the Portuguese that unless they closed their forts to the British by 1 Sept. 1807, he would declare war upon the Prince Regent. As Portugal did not acquiesce, a secret convention was signed at Fontainebleau, 27 Oct. 1807, between France and Spain, providing for the joint conquest and partition of the Portuguese kingdom. The conquest was rapidly effected, and as Junot (q. v.) with 1,500 famished grenadiers struggled into Lisbon, 30 Nov. 1807, the Prince Regent and the royal family fled to South America. But meanwhile Napoleon was preparing to overthrow the Bourbon house in Spain. The court of Madrid had secret grudges against the French Empire, and in a moment of infatuation during the summer of 1806, the Spanish army had been mobilized, with a view of rejecting the treaty of Ildefonzo, which had been the source of the destruction of the Spanish navy. But Jena upset the calculation of Godoy, the miserable favorite, who held the reins of Spanish policy. He explained away his action, protested friendship, showed himself in the treaty of Fontainebleau, prepared to connive at the destruction of the house of Braganza, and did not for a moment deceive Napoleon. The Portuguese campaign, and the dissensions between Charles IV. and his son Ferdinand, gave to Napoleon the pretext for interference. French troops were sent across the Pyrennees, nominally for the purpose of supporting the army of Portugal, really in order to effect the subjugation of the country. Finally the royal family was enticed to Bayonne, and father and son compelled, 5 May 1808, to renounce their claims to the throne. Joseph was sent to govern in Madrid, while Murat, the grand duke of Berg, took his place in Naples. By the middle of May the whole Iberian peninsula had nominally become an annex of the French Empire. In reality the gravest mistake had been committed. An English army under Sir Arthur Wellesley (q. v.) defeated Junot at Vimievo 21 Aug. 1805, and forced the French to evacuate Portugal, while the Spanish people, passionately loyal to the fallen dynasty, hating the French revolution, and impervious to the charms of a scientific administration, everywhere rose in revolt. On 22 July 1808, a large French force under Dupont (q.v.) capitulated at Baylen. It was the first serious military reverse which the French Empire had sustained.

The Austrian war of 1809 was the natural sequel to the insurrection of the Spanish people. Germany was smarting under the hardships involved by the French military occupation and the continental blockade; and the deepest resentment was caused by a decree issued by Napoleon, commanding the banishment of Stein (q. v.), the great reform minister from Prussia. Every German who hoped for better things, looked to Austria as the destined liberator; but again the genius of Napoleon overcame all obstacles. Five brilliant battles (19–23 April) drove the Archduke Charles out of Bavaria. On 13 May, Vienna surrendered to Napoleon. On 6 July he won the hard fought field of Wagram. The English diversion at Walcheren was as ineffective as the gallant raid of Colonel Schill or the march of the Duke of Brunswick's black legion through northern Germany. On 14 Oct. 1809, Francis of Austria accepted the treaty of Schönbrunn, and abandoned the Tyrol, Trieste and the Illyrian littoral to the conqueror. The Tyrolese, who, under the leadership of Andreas Hofer (q.v.), an innkeeper, had made a gallant resistance to the French, were now easily overcome, and while their leader was shot, to the eternal disgrace of Napoleon, their territory was divided between the kingdoms of Italy, Bavaria, and the Illyrian provinces of the French Empire. Nor was this the last affront to Austrian pride. Divorcing Josephine, Napoleon demanded and obtained the hand of Marie Louise, the daughter of Francis. The French Empire had now reached its zenith, though some further rearrangements of territory were effected, mainly for the purpose of improving the mechanism of the blockade. Thus Louis, who was considered to be too lenient to the Dutch, was compelled to abdicate, and the kingdom of Holland was annexed to the Empire on 9 July 1810; while at the end of the year (Dec. 1810) the northwestern portion of the Westphalian kingdom, and all the northwest littoral of Germany, including Bremen, Hamburg, Lübeck were similarly incorporated and organized as French departments. The rigor of the blockade now reached its height. Heavy duties were placed upon all colonial imports by the Trianon tariff, 5 Aug. 1810. The Fontainebleau decrees (18 and 25 Oct.) ordered that all British manufactured goods found in the Napoleonic states should be seized and publicly burnt, while 51 tribunals were established for the purpose of trying persons accused of contraband. So eager was Napoleon to complete the system that in Jan. 1811, he dethroned the Duke of Oldenburg, the uncle of the Czar.

The French Empire by this time consisted of 130 departments, stretching from the Ebro to the Trave, and from the Tiber to the Channel, and girt with a circle of vassal kingdoms and principalities. Throughout this vast area the valuable principles of social equality, religious toleration, and promotion by merit were enforced. Though the codes of the Empire were more perfunctory, more observant of older legal traditions and less liberal than the civil code, which was the work of the consulate, yet they preserved two valuable conquests of the Revolution, the petty jury and public trial. If the essence of democracy was, as Napoleon contended, «a career open to talent,» than the French Empire was democratic; but in every other respect it violated the principles of liberty. Special courts were created with summary jurisdiction in the disturbed districts. The censorship of the press (aggravated by the decree of 5 Feb. 1810) annihilated political criticism. Holding that there could be no political stability without «a teaching body actuated by fixed principles,» Napoleon created 17 March 1808, a University of France, which was intended to include all the educational agencies in the Empire, and to form citizens «attached to their religion, their prince, their country, and their family.» No one could open a school or teach in public without being a graduate of the university, which was to create and administer the public and to authorize and supervise the private schools. The university was divided into 17 academies, one in Paris and 11 in the provinces, and governed by a grand-master, whose appointment and dismissal lay in the hands of the Emperor. The aim of the whole institution was to inculcate habits of military discipline and blind subservience, and to secure complete educational uniformity throughout his Empire. An Imperial catechism, drawn up by Napoleon himself and inculcating obedience to his person, was intended to give a similar direction to the public mind. To fortify the dynasty, Napoleon saw that it was necessary to create an hereditary nobility, but the opposition which had been made to the Legion of Honor in the name of equality warned him to proceed with caution. In the first instance he began by distributing foreign fiefs and titles, carving no less than 17 duchies out of the Venetian states; then (Aug. 1806) license was given to exchange grand ducal fiefs for estates within the territory of the Empire, and to transfer to estates so acquired the privilege attaching to noble tenure. Finally, on 1 March 1809, a new nobility was created, the titles to be hereditary and the noble lands to be entailed. In all, 31 dukes, 388 counts, 1,090 barons, and about 1,500 knights were created under the first Empire; but Napoleon was uneasily conscious that aristocracies were the product of time, and that the nobility of the Ancient Régime despised the upstart dignitaries of the Empire. «I have made princes and dukes,» he said at Saint Helena, «but I could not make real nobles.»

In France the burden of the Empire was great; but it was still more crushing in the dependencies. It was part of Napoleon's system to reserve half the domains in every vassal state to serve as endowments to generals or favorites, or to help to replenish his imperial treasury. In addition to this, the dependencies were subjected to the conscription and the blockade, compelled to support the French troops who might, from time to time, be quartered on them, and to maintain war establishments quite out of proportion to their financial resources. Thus the benefits secured by the introduction of the French legal codes were largely neutralized; and the French rule became detested all over Germany and Italy. The conscription was everywhere abhorred, while the blockade inflicted great injury wherever, as in Holland or the Grand Duchy of Berg, commerce or industry had been active. If the Italian, Dutch and German merchandise had been permitted a free entry into the French markets the lot of the mercantile and industrial community might have been alleviated; but in this, as in other respects, Napoleon sacrificed the interests of the French dependencies to those of France herself.

The reconciliation with the Papacy, which had been one of the principal achievements of the consulate, was broken under the Empire. The Papal States were annexed to France, 17 May 1809, by a decree recalling the donation of Constantine, and Rome was declared to be a free imperial town. Pius VII. retaliated by excommunicating the despoilers of the Church, and the bull was secretly circulated through the Empire. For this act of temerity he was seized 5–6 July 1809, and carried off to Savona, where he was kept a prisoner. Difficulties, however, soon arose. The Pope refused to institute the bishops named by Napoleon; and Napoleon failed to coerce him. The cardinals and generals of the Orders were convoked to Paris, and the archives of the Roman administration were similarly transferred to the capital of the Empire. By a decree of 17 Feb. 1810, the Pope was guaranteed a salary of 2.500.000 francs, given a palace in Paris, while at the same time it was ordained that all future Popes should at their enthronement swear to observe the Gallican articles of 1682, which were declared common to all the churches of the Empire. This bold and revolutionary measure aroused great protests. Thirteen cardinals refused to attend the Emperor's marriage with Marie Louise, and were in consequence banished to provincial towns and prohibited from wearing the purple A national council (17 June to 5 July 1810) gave Napoleon no satisfaction, but at last a mutilated remnant of the assembly was induced to declare that the right of institution to vacant sees lapsed to the metropolitan in case the Pope failed to grant institution within six months after the see fell vacant. The Pope signed a brief accepting this conclusion, but in a form which was distasteful to Napoleon, and the sore remained open. At last, after the Russian disaster, Napoleon was induced (concordat of Fontainebleau 25 Jan. 1813) to renounce his claim to the Catholicity of the Gallican articles, while the Pope on his side confirmed the conciliar decree on the institution of bishoprics. But good feeling was never restored, and the alienation of the Catholic Church was one of the greatest errors of the Napoleonic Empire.

The downfall of the Empire was the natural result of Napoleon's ambition. The Peninsula war drained France of her finest troops, relieved the pressure on Prussia, and prevented Napoleon from carrying out the designs on the Balkan peninsula, which had been part of the secret arrangement at Tilsit. Other causes contributed to weaken the Franco-Russian alliance, —Napoleon's encouragement of the Poles, the continental blockade, the Austrian marriage, the annexation of Oldenburg. War broke out in 1812, and Napoleon led a huge army to Moscow. He retreated among the rigors of a Russian autumn (Oct.–Dec.), lost a quarter of a million men, and shattered his prestige. First Russia, then Austria, ranged themselves on the side of the allies. A crushing defeat at Leipzig (16–19 Oct. 1813) compelled the evacuation of Germany, and brought about an invasion of France. Though Napoleon fought a brilliant campaign in the valleys of the Marne and the Seine against the Prussian and Austrian armies, the allies eventually pressed on to Paris. On 30 March 1814, the defence of the capital was surrendered by Marmont, and on 6 April, Napoleon signed an act of abdication at Fontainebleau, and was allowed to retire to Elba. His dynasty was proscribed. On the advice of Talleyrand, Alexander of Russia, who had entered Paris at the head of the allied armies resolved to recall the Bourbons. So perished the Empire in a blaze of military glory, which France will never forget.

On his return from Elba in 1815, Napoleon, realizing the growth of liberalism, made a pretense of liberalizing the imperial institutions, and Benjamin Constant, who had led the opposition to Louis XVIII. was summoned to draw up a constitution. The defeat of Waterloo supervened before any serious trial had been made of the Additional Act, which established an hereditary Chamber of Peers, an elected chamber of representatives, and at the same time guaranteed the freedom of the press; but it cannot be doubted that had Napoleon succeeded in reestablishing his powers, he would have made short work of liberals and of liberalism. At Saint Helena, however, he professed that the despotism of the Empire had been a transitional expedient, and that the future of liberalism and nationality in Europe were bound up with the fortunes of his house; and this was the creed of the Bonapartist party, and the pretext and apology for the second Empire.

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5. France—History Since 1815. The history of France since 1815 is the history of the events that led up to the establishment of the Republic and of democracy. This establishment was not the result of a continuous development but of a series of crises followed by periods of reaction, each crisis making a progress, or as Mr. Seignobos says, «carrying off from the old monarchy a fragment that could not be restored.»

The first crisis is the Revolution of 1830 which put an end to the government of the Restoration. When the allies in 1814, at the fall of Napoleon, reinstated the old dynasty, what the people demanded was peace and also the preservation of the chief reforms got from the Revolution, viz., equality of rights, the selling of the *biens nationaux*, the essentials of political liberties and a chamber of representatives elected by the Nation. To these demands the charter of 1814 gave almost entire ratification; besides, the personal temperament of King Louis XVIII. (1815-1824) was of a conciliatory turn. But he had to strive against the «Ultras» who were uncompromising royalists, and whose chief was the King's own brother, the Count of Artois. This party wanted to restore the former régime of absolute monarchy, in its aristocratic and intolerant form. It was the Ultras who led the movement of violent reaction known as the «White Terror,» and who, being the majority in the chamber of 1816 (called Chambre Introuvable), placed the monarchy in such an awkward position that the King had to get rid of them by a *coup d'état.*

For three years, from 1817 to 1820, Louis XVIII. governed with moderate and liberal-minded ministers. This short period is of great importance; then for the first time were adopted in France those customs that are the necessary adjuncts of a constitutional and representative government, periodical election, annual vote of the budget, the liberty of discussion in the Chamber and, within certain limits, the liberty of the press. It was the régime of the *Monarchie Censitaire,* so-called because the political power belonged to the moneyed classes, only those who paid taxes (or *cens*) to the amount of 500 francs being voters, and those who paid 1,000 francs having a right to be elected.

It is easy to conceive that this policy of Louis XVIII. encouraged the liberal aspirations of the Nation; it vexed the Ultras who succeeded in putting a stop to it, thanks to two favorable circumstances. First they obtained the support of the aristocratic governments of Europe (Prussia, Austria, Russia) that had pledged themselves at the Treaty of Vienna to oppose revolution in any country, and that were already growing anxious at the manifestations of liberalism not only in France, but in Germany, Italy, Spain and the Spanish colonies of America. At the Congress of 1819 at Aachen, remonstrances were made to the French embassador. The second circumstance was the murder of the Duke of Berry (1820) by a lunatic called Louvel. The liberal party was held responsible for it, and the Ultras again seized the power, which they retained till the Revolution of 1830 (except for the short interval of the Martignac Ministry, 1828-1829), under the direction of the Count of Villèle (1820-1827) and afterward of the Prince of Colignac (1829-1830). The reaction of the Ultras was both aristocratic and catholic in character: they endeavored to establish the preponderance of the class of the great landlords, and the authority of the Catholic Church. This reaction reached its climax in the reign of Charles X. (1824-1830), the Count of Artois, who succeeded Louis XVIII. Abroad the Ultra government supported the reactionary policy of Metternich; it was a French army, under the command of the Duke of Angoulème that overcame the Spanish Revolution (1823). Afterward they joined with the English and the Russians in the intervention in favor of the Greeks (1826-1829), and began the conquest of Algeria (1830), but without regaining their lost popularity.

Against the Ultras a coalition was formed that included the modern royalists, the Gallicans, the manufacturers and tradesmen, and the whole of the working classes; as a consequence a majority hostile to the Ultras was sent to the Chamber. In the hope that this majority would not again be returned, Charles X. had twice recourse to a dissolution; but this proving of no avail, he resolved to transgress the charter by a *coup d'état*. The elections were annulled, the electoral laws altered and the liberty of the press momentarily suppressed. These were the famous «July Ordinances.» This *coup d'état* was immediately answered by the Revolution of 1830, originated by a small group of republicans that belonged to secret societies and were chiefly recruited among the undergraduates, the workmen, and people of the middle-classes. After three days' fighting Charles X. was dethroned. But a reaction began at once. In the first place the republicans, few as they were, could not prevent the monarchy from being maintained as the form of government; only another dynasty was called to the throne, that of the d'Orléans who were cousins of the former king, and a pledge was exacted from the new sovereign to adhere to the charter. In the second place, on account of the riots that had broken out in Paris and Lyons, and the manifest signs of a new revolution approaching, the republicans were prosecuted and dispersed by the government. So the crisis of 1830 did not end in the establishment of the Republic, but it founded forever the sovereignty of the Nation with a constitutional government.

The second crisis is the Revolution of 1848, which brought to a close the reign of Louis-Philippe (or July Monarchy, so-called from the Revolution of July 1830). The most characteristic features of this reign are with regard to foreign policy the alliance made with England to ensure peace on a durable basis, and at home the ascendency of the well-to-do classes. The electoral *cens* was indeed lowered, but only to 300 francs for the voters, and 500 francs for the candidates, which still excluded from public affairs both workers and people of small income alike. Now the epoch of Louis-Philippe was marked by an unprecedented development of all manufacturing industries, which created in France as everywhere in Europe a vast proletariate. This proletariate began to ask loudly for laws that should protect them against their employers and even alter the conditions of individual property. The socialistic theories were growing more definite, and the socialists as a party were slowly emerging. Of course the Chambers, elected as they were by the capitalists, could not reject these demands that were aimed against them. The natural consequence of their attitude was a campaign of the socialists and republicans, supported by a large majority of the people, in favor of universal suffrage, or at least of an extension of the right of voting. The resistance opposed by the Guizot Cabinet to this movement caused its fall, and at the same time the fall of the reigning dynasty. Once more the republicans allied to the socialists, provoked a revolution in Paris (February 1848), dethroned Louis-Philippe and established a republican government.

This time the reaction did not take place immediately, and had two distinct stages from 1848 to 1851. There was first a reaction of the republicans against the socialists: the two parties, after uniting to found the Republic and institute universal suffrage, disagreed on the subject of social questions. In June 1848, the republicans shut up the «National Workshops» lately opened by the socialists and ordered a ruthless repression of the riot that ensued. Then there was the reaction of the monarchists and of a newly revived party of Bonapartists against the republicans themselves. The fear of a revolution was cleverly directed against the republican government and speculated upon to bring to the presidency of the republic a nephew of Napoleon I., the prince Louis-Napoleon. The monarchists hoped that he would serve their plans, but he only served his own interests: at the head of the different ministries and public services he appointed men on whom he could entirely rely; and with their co-operation and with the help of the clergy he effected the *coup d'état* of 2 Dec. 1851. The Assembly was dissolved, about 100 deputies were exiled and several insurrections that broke out in Paris and the provinces were sternly put down. A new Constitution was then drawn up that was almost a copy of the Constitution of the year VIII. with the addition of universal suffrage; and the following year Louis-Napoleon had himself proclaimed Emperor of the French, under the name of Napoleon III. Thus the crisis of 1848, in spite of momentary success, cannot be said to have established the Republic; but at all events it strengthened the former acquisition of the people, viz., the sovereignty of the Nation, and maintained their more recent conquest, universal suffrage.

The third crisis is that of 1870. The Second Empire was at first a highly despotic government: every newspaper had to be authorized and was under a censorship, the elections were controlled by the government that required from all candidates alike an oath of allegiance and supported openly its own candidates, the Chambers were deprived of the fundamental rights of deliberating assemblies, the rights of initiative, of amendment and of interpellation; their sittings were not public and reports of their proceedings could not be published; lastly a regular system of political inquisition was established. These were, until 1860, the characteristics of the Imperial government which depended upon the same coalition of conservative interests that had brought it to power and chiefly upon the Church, that was rewarded with the liberty of teaching and a kind of control over the university.

The events abroad obliged the Emperor to modify his policy at home. «The Empire is peace,» were the proper words he had used in 1853 to remove the fears of the French as well as of the foreign powers; yet France under Napoleon III. was engaged in several wars. The first was the Crimean War (1855), which served at the same time the interests of the English and the traditional spite of the French against the Russians. Then there was in 1859 the Italian War into which he was led, perhaps in spite of himself, by a pledge he had formerly taken as a *carbonaro* and by Orsini's outrage, and from which France gained the Savoy and the county of Nice that have been French territory ever since. This war was the most important event in Napoleon's reign, for it opened the «Roman

Question» and dissatisfied the French Catholics who never forgave Napoleon III. his allowing Vittorio Emmanuele to seize the Pontifical States. From that time the Emperor was obliged to form a new majority from the ranks of the liberals and to alter his policy. From 1860 to 1870, and chiefly after 1868, the Empire was liberal: the government became truly representative, the elections were no longer controlled, the press was freed from former restraints and meetings were allowed unconditionally. Napoleon trusted this change of tactics would disarm the opposition of the liberals and the republicans; in fact it furnished them with arms against him. Liberals, republicans, monarchists and Catholics, all joined in an attack against the Empire and were decidedly successful at the elections of 1863 and 1869. The failure of the Emperor's foreign policy brought them further assistance: the «Roman Question» grew so entangled that French troops had to be kept in Rome after the battle of Montana; the Mexican War that partook as much of the crusade as of the financial venture, and that was brought to an end by the intervention of the United States, had a lamentable conclusion; lastly serious differences were growing between France and Prussia whose designs in Germany Napoleon III. neither encouraged nor opposed frankly and toward which he carried on, without the least success, a policy which Bismarck graphically described as «a policy of tips.» The Imperial government thought that a war with Germany would be a convenient way out of all these difficulties: a victory would have consolidated the tottering dynasty. The defeats of Frœshwiller and Sedan completed its ruin. As in 1830 and 1848 it was an insurrection of the republicans in Paris, immediately followed in most of the provincial towns, that upset the second Empire and proclaimed the Republic (4 Sept. 1870).

This time there was, properly speaking, no reaction, but only an attempt at a reaction, and this failed. So long as the war lasted, the republicans retained the power with the *Gouvernement Provisoire,* the most famous member of which was Gambetta. But in order to ratify the preliminaries of the peace, they had to summon an assembly: this was the *National Assembly* that sat first at Bordeaux and afterwards at Versailles. The election took place in most exceptional circumstances: the large majority of the Nation was strongly in favor of peace; on the contrary the republican candidates, like Gambetta, were for carrying on the war to the last, so that the electors, chiefly the peasants, voted for royalist candidates, and the majority in the assembly (some 375 out of 700) was composed of monarchists. But a reaction was not so easy then as in 1830 or 1848; the republican idea had gained ground in the departments of the East, of the South and of the Centre; the party of the Bonapartists had been swept away by the disastrous war, and above all the monarchists themselves were divided in two parties, the *legitimists* who supported the Count of Chambord, a descendent of Charles X., and the *Orleanists,* the Count of Paris, a descendant of Louis-Philippe. These two parties at first silenced their personal ambitions to sign the Treaty of Frankfort and to strive against the insurrection known as the *Commune de Paris;* they further agreed to intrust provisionally the executive power to M. Thiers on whom they officially conferred the title of President of the Republic for this was the only name then available but without feeling bound thereby to accept the Republic as the definite form of government. Both parties hoped they would come to an understanding and ultimately unite, but this hope was frustrated, first by M. Thiers himself who refused to be a party to any restoration and resigned his office 24 May 1873; secondly by the Count of Chambord who persisted in claiming as the National emblem the white flag that was the symbol of absolute monarchy and therefore was as much detested by the Orleanists as by the republicans and Bonapartists. On the other hand, by elections and in every other manifestation of public opinion, it was clearly visible that the republican party was everywhere gaining favor; so that the majority in spite of their monarchic tendencies were at last reduced to vote a republican Constitution which began to work in October 1875, when the *National Assembly* broke up and was replaced by two Constitutional Chambers: the Chamber of Deputies and the Senate.

Then the victory of the republicans could be deemed complete: the government of the country was officially a parliamentary republic with universal suffrage, and the majority in the Chamber of Deputies was republican. Yet both MacMahon (who had succeeded Thiers as President), and the Senate still belonged to the conservative party. The latter resolved once more to try their fortune: on 16 May 1876, the republican minority was dismissed and the Chamber dissolved. But MacMahon shrank from the responsibilities of a *coup d'état,* the elections again sent to the Chamber a republican majority, later on the senatorial elections also placed a republican majority in the Senate; MacMahon had to give up the Presidency and the republicans appointed in his place one of their own men, J. Grévy. Since that date the internal history of France has only to deal with the normal development of her democratic institutions. This development has operated in three principal directions: (1) In the confirmation of political liberties (press, meetings, associations); (2) In the complete secularization of all public services (primary education laicized and made compulsory and gratuitous, divorce, suppression of the religious orders, disestablishment of the Church); (3) In social laws that authorize strikes and trades-unions, enforce certain sanitary regulations in workshops and factories, determine the employer's liability, regulate the work of women and children, limit the working-hours and secure a weekly day's rest to all employees. In spite of the eagerness of the conflict between the different political parties (the moderate or *opportunists,* the radicals and the socialists), the internal peace of the country was not once seriously disturbed. There were, however, two junctures when circumstances assumed a character of particular consequence. The first was what has been called *The Boulangisme* (1887-1889). A coalition was then formed under General Boulanger between the monarchists, the Bonapartists and a fraction of the republican party, dissatisfied at the policy of the *opportunists*, with a view to overthrow the Republic and restore the Monarchy or the Empire under the name of «Plebiscitary Republic.» Boulanger and his supporters took advantage of the *plurinominal* ballot (*i. e.* balloting for a list of persons), to stand candidates in all the departments at once, which amounted to trying a plebiscite. The government checked the movement by restoring the *uninominal* ballot and depriving candidates of the right to stand for more than one constituency at a time; besides it dispersed the leaders of the movement by having them tried for high-treason before the Senate. The second of these junctures was the Dreyfus case, which, owing to its political consequences, had all the importance and significance of a real revolution. First of all it determined a new grouping of the parties: on one side the *Nationalists* recruited from among the monarchists, the anti-semites and a fraction of the progressists, relying for support on the conservative forces (army, religion, capital); on the other side the republicans, radicals, socialists and the remainder of the progressists united into the so-called *bloc* to fight against the same conservative forces in the name of individual right and of justice. The greater cohesion of the parties gave renewed vigor to the political life of the country: from that period date the creation of political leagues as *Les Droits de l'Homme* and *La Patrie Française*, the foundation of the popular universities and of several new journals, and also the interference of the trades-unions in politics. All these influences combined to bring to power such governments as those of Waldeck-Rousseau, Combes, Rouviers, Sarrien, Clemenceau, under which (from 1898 to 1906) the social reforms enumerated above have been accomplished. Since the Dreyfus case two principal tendencies are discernible in the general trend of French politics: one, which brought about the ruin of the denominational schools and the disestablishment of the Church, is irreligious; the other is socialistic: though the party in power still vindicates individual property as the actual basis of society, the nationalizations that are part of its programme are essentially socialistic and at all events can only be worked out with the help of the socialists.

If the progress of democracy has been the characteristic feature of the internal policy of the French since 1870, the maintenance of peace has been the constant object of their external policy. To this peaceful disposition must be ascribed the Franco-Russian alliance and the many treaties signed of late with England, Italy, and even with Japan. May be that to a few individuals these alliances have seemed to offer an opportunity for some underhand action against Germany, but the recent Morocco incident has shown how sincerely the people at large are determined to reprove all manner of aggressive policy.

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6. France—The Government. I. *Constitutional Laws.*—Strictly speaking, the political régime of France cannot be defined as a Constitution but as three separate laws, called constitutional or organic, voted in 1875 and amended by two other laws, one in 1879 and the other in 1884. Strange as it may seem, these laws which make up the political mechanism of the Third Republic were prepared and accepted by an assembly in which monarchists constituted the majority. In fact, of the 750 members composing the National Assembly elected by universal suffrage in February 1871, about 420 were monarchists, the peasantry having voted for the monarchists who favored peace rather than for the republicans who wanted war. However, in spite of their majority, the monarchists were powerless to restore royalty in France, and that for two reasons: (1) the views held by French citizens were so manifestly hostile that M. Thiers, minister to King Louis-Philippe and a strong Orleanist, chosen as «chief of the executive power» and provisional president of the new government by the monarchists, who counted on using him to bring about a restoration, openly declared himself for the Republic, thereby causing his downfall in 1875, when he was replaced by Marshal MacMahon; (2) the monarchists were divided into two rival factions, each of which supported a different candidate for the throne, the *Legitimists* being the partisans of the Count of Chambord, a descendant of King Charles X., dethroned in 1830, and the *Orleanists*, adherents of the Count of Paris, a descendant of King Louis-Philippe, dethroned in 1848. At one time harmony or fusion, as it was then called, seemed about to be realized between the two parties, as the Count of Paris had acknowledged the anterior and superior claims of the Count of Chambord, who, on his side, had legitimatized the dynasty of Orleans by accepting as successor the Count of Paris. But the Count of Chambord forfeited everything by obstinately rejecting the tricolored flag, symbol of the new revolutionary France, and favoring the white flag, symbol of the France of the old régime and of the divinely authorized monarchy. Therefore, Orleanists and Legitimatists resumed their former positions and resigned themselves to a parliamentary republic which put them temporarily on terms of agreement by eliminating the two rival claimants. According to an amendment to the law on the organization of executive power, known as the Wallon amendment, it was decided in the name of the new government, to confer upon the chief of the executive power the title of President of the Republic, and in memory of this amendment M. Wallon was jocosely called «Father of the Constitution.»

These circumstances explain the absence of a Declaration of rights and a co-ordinated

Constitution, such as exists in the United States of America and existed in France from the Constitution of '91 to that of 1848.

The following are the three constitutional laws:

1. *The Law of 24 Feb. 1875,* relating to the organization of the Senate. It regulates the number of senators, the conditions of eligibility, the mode of election and renewal and the power of the assembly.

2. *The Law of 25 Feb. 1875,* concerning the *organization of public power.* It defines the exercise of legislative power, the mode of dissolving the Chamber, the ministerial responsibility, the method of amendment, and fixes the seat of government and of the Chamber of Versailles.

3. *The Law of 16 July 1875,* treating of the *relations of public power.* It deals with the meetings of the Chambers, their prerogatives and the connection of the executive power with the Chambers.

The laws of amendment are as follows:

1. *The Law of June 1879,* suppressing the constitutional residence at Versailles and transferring it to Paris.

2. *The Law of 14 Aug. 1884,* excluding from the presidency members of ancient dynasties and forbidding the republican form of government to be called into question and suppressing irremovable senators and public prayers.

Of these five constitutional laws one has now almost completely disappeared, that is the law concerning the Senate. Of the four others, exclusively relative to political organization, only the following facts are constitutionally established:

1. The existence of a *legislative power* divided into two assemblies, the Senate and the Chamber of Deputies, concerning the organization of which the Constitution mentions only the functions, the interior organization, the privileges of members and the election of deputies by universal suffrage.

2. The existence of a *President of the Republic,* the complete enumeration of his functions and prerogatives and directions in regard to the mode of election and the duration of power.

3. The *reciprocal powers* of the President and the Chambers either in regard to each other or to common questions, such as the convocation of the Chambers, length of sessions, form of dissolution, general procedure of amendment, forms of presidential and ministerial responsibility, method of promulgating laws and concluding international conventions.

Everything outside of these matters depends upon legislative action; the electoral system, ministerial organization, communal, departmental, judiciary, military and financial administration, etc. However, one question remaining outside of both constitution and legislation is the form of government. Contrary to preceding constitutions, these constitutional laws give the greatest scope to legislative action and tend to confound the legislative and constitutional authority.

II. *The Principle of the Separation of Powers.*—It is the opinion of the authors of the constitution of 1875 and of those who interpreted and applied it, that its fundamental and, in a way, its vital principle is that formulated according to Montesquieu under the title of separation of powers. «All would be lost,» says Montesquieu ('Esprit des Lois XI,' 6), «if the same man or the same body of leaders or of nobles or of people, were to exercise these three powers, that of making laws, of executing public resolutions and of judging crimes or individual disputes.» It is important briefly to examine this opinion. Montesquieu's idea may be taken in two different senses. It may signify that the same individual or the same body cannot be simultaneously and successively a legislator, an executing agent and a judge; if so, it is a critical reflection upon the absolute monarchy wherein the king claims the right to make, execute and apply the law himself, or to act in like manner through his agents; every superintendent having a jurisdiction and every minister a *lettre de cachet.* Such a system begets not alone tyranny but, above all, confusion and anarchy. Therefore, if, by separation of powers, Montesquieu meant a division of functions, the assignment of a definite function to each, or, better still, the dedication of each function to a special staff, his idea was simple, elementary and just. But it is not more characteristic of the constitution of 1875 than of any other; it is characteristic rather of modern governments nationally organized. However, if Montesquieu's idea is—and it has been thus interpreted, the interpretation seeming a true one—that in every society there exist three self-governing powers whose parallel action must be separately exercised, independent in their origin and in their course and concurring only in their results; and that a constitution is the affirmation and solid organization of these three powers, on the one hand, the principle does not seem to be admitted by the constitution of '75, while on the other it does not appear admissible. The principle of the separation of powers is not admitted in the constitution of '75, (1) because this constitution does not organize an independent judicial power; (2) because, in this constitution, the legislative power chooses and superintends the executive power; (3) because, in this constitution, the legislative holds the judicial functions; (4) because the executive convokes, prorogues and dissolves the legislative. On the other hand, this principle is not in itself admissible because it is antinomical. A first reason for this is that social life is the result of a collaboration, of a reciprocal penetration of the various forms of activity and not of their parallel isolation. A second reason is that all powers, in no matter what government, emanate from a common source, *i. e.* monarchical or national sovereignty, and that, as representative of that sovereignty, the legislator is the common master of him who executes and of him who judges. Hence in the principle of the separation of powers we can admit only the practical distinction between executive and legislative that serves as a basis of the constitution of 1875, and according to which we shall analyze it.

III. *The Legislative Power.*—The two powers established by the constitutional laws have been accurately stated and defined by a combination of laws forming the real constitution.

1. *The Election of Representatives.*—(*A*) *The Chamber of Deputies.*—The application of

universal suffrage was regulated by the laws of 20 Nov. 1875, and of 13 Feb. 1889, both of which bear upon a great many points in the laws of 31 May 1850, and of 2 Feb. 1852. *Electors.*—Any citizen over 21 years of age enjoying civil and political rights, domiciled for six months in a district and enrolled on the electoral lists, is entitled to vote, which right is, however, withheld from all military men actively engaged either on land or sea. *Eligibility.*—Any citizen fulfilling the aforesaid conditions is eligible except in the cases prohibited by law, *i. e.* where one is a member of an old dynasty or holds a government office within his own province. Moreover, numerous *incompatibilities* prevent the cumulation of a public office and a legislative mandate. Exceptions are made in favor of ministers, prefects of the Seine and of police, chief magistrates of the high courts of Paris and professors of the University. All candidates must declare their candidacy at least five days before the voting so as to prevent one individual presenting himself as a candidate in more than one constituency, such plural candidatures being forbidden by the law of 1889. The voting is by ballot, one deputy being named for each arrondissement; however, when an arrondissement has more than 100,000 inhabitants, it is divided into electoral districts, thus bringing the present number of Deputies up to 583. (The vote is by secret ballot on a white paper—«bulletin»—folded and deposited in the ballot-box by the chairman of the voting-bureau, who is always a municipal magistrate, assisted by four assessors appointed by the electors at the opening of the poll; the hours of voting are from 8 o'clock in the morning to 6 in the evening. A rough count by a committee of the electors themselves follows immediately on the close of the poll, before the official recount. This rough count consists in the exercise of the right of such a committee to open all the voting papers.) The law prescribes two ballots at an interval of 15 days; to be elected on the first ballot, a candidate must have an *absolute majority* (half the votes plus one); on the second ballot, called *ballotage*, and brought into play only if the first ballot is inconclusive, a majority of votes cast suffices. Deputies are elected for four years, the full number of the chambers being elected on one and the same day.

(*B.*) *The Senate* is composed of 300 members, the number determined by the constitution. Since the amendment of 1884 all senators are elected to office, the 75 life-senators appointed by the Senate and created by the constitution, having been then suppressed. Senators are elected from each department, their number varying from 2 to 10, according to the population. The suffrage is called *limited;* the electoral body is formed of it: (1) the *departmental representatives* (senators, deputies, general councillors); (2) *senatorial delegates* elected from among the voting citizens of each township by the municipal council and varying from 1 to 24 according to the population. These senatorial electors constitute a college that meets at departmental headquarters under the presidency of a civil magistrate. The election must end on the day of the third ballot, the first two being cast to find, if possible, an absolute and the third failing an absolute majority for a majority of votes cast. Senators are elected for nine years, some of their number being renewed every three years. Hence, the Chamber of Deputies represents the people as a whole and the Senate *local* bodies. Gambetta called the Senate the Great Council of the Communes of France.

2. *Prerogatives.*—(*A.*) The members of both Chambers enjoy the same personal prerogatives, inviolability from arrest and a fixed salary (15,000 francs to Deputies—9,000 to Senators). (*B.*) They exercise the same *legislative* privileges; adopt their own rules and elect their own committees. Their essential privilege consists, as in all other parliaments, in *introducing* and *voting* laws. In this regard the only difference between the Senate and the Chamber of Deputies is that all finance laws must first be voted by the Deputies. All laws must be voted by each Chamber separately. Only the laws of amendment to the constitution are voted on in another fashion; for these both Chambers combine and form a congress held at Versailles. (*C.*) Both Chambers assembled in congress at Versailles exercise an electoral privilege also, that of electing the President of the Republic. (*D.*) The Senate alone enjoys the judiciary privilege and constitutes itself a High Court to judge the President of the Republic and ministers arraigned by the Chamber of Deputies, as also individuals accused of conspiring against the security of the state (the Boulanger affair in 1889 and the Deroulede in 1899). (*E.*) Finally, each Chamber exercises a similar power over the ministry through the right of *question* and *interpellation.* The latter is especially important inasmuch as the minister summoned is obliged to respond and the interpellation is followed by a vote, after which, unless he receive a majority, he must retire. Interpellation is the practical mechanism through which the ministerial responsibility is exercised. Either Chamber may further control the Government by naming a commission of parliamentary inquiry (the Panama and Boulanger affairs, the condition of the Navy, etc.). The Chambers, especially that of Deputies, exert a really dominant influence over the French Government.

IV. *The Executive Power* is exercised by the President and his ministers. (1) *The President* is elected by Congress (Deputies and Senate combined) for seven years, being chosen from among its own members. His power is very extensive, as he can introduce, promulgate and execute laws, make appointments to all civil and military offices, dispose of the armed forces and negotiate and sign treaties. But, since he can exercise it only through the medium of his ministers, this extensive power is practically reduced to that of appointing his ministers. Being politically irresponsible, he can only be summoned before the High Court for felony. He resides in the Palais de l'Elysée in Paris, and receives a regular salary of 600,000 francs, with as much more for expenses incidental to official entertaining. List of Presidents of the Republic: Thiers, 1871-1873; MacMahon, 1873-1879; J. Grévy, 1879-1888 (the only one re-elected); Carnot, 1888-1894; Casimir Périer, 1894-1895; F. Faure, 1895-1899; E. Loubet, 1899-1906; Faillières, 1906—. (2) *The Ministers* form a jointly responsible Cabinet under the direction of the President of the Council.

The latter is appointed by the President of the Republic and is free to choose his colleagues: 12 ministers — Justice, the Interior, Foreign Affairs, War, Navy, Colonies, Public Instruction, Commerce, Agriculture, Public Works, Finance, Labor — the last created in 1907. They are the President's deputies, who, in his stead, sign or veto all executive documents. Their essential character is their *political responsibility*. They are responsible for their acts to both Chambers, whose members, thanks to the right of interpellation, already defined, can put their actions to a vote which, if it place one or more in a majority, will entail his or their resignation. Such a consequence is not explicitly declared in the constitution, but it follows in the logical order and from the practice of the Government. In fact, in case of conflict between a minister and the majority, two solutions may be resorted to: either the minister's resignation or the dissolution of the Chamber, which must be voted by the Senate. Throughout the history of the Third Republic there is but one record of a like dissolution, which was that of 16 May 1876. President MacMahon had formed the conservative ministry of the Duc de Broglie in opposition to the liberal Chamber, which, by a majority of 363, refused to enter into relations with him. The Chamber was dissolved, the elections resulted in a majority of liberal votes, in face of which the conservative ministry had to submit and resign. Since then, all ministers in the minority on a *matter of confidence* have tendered their resignations. During the first 20 years of the Republic ministerial instability was a veritable governmental defect, being due to the disintegration of parties and the impossibility of constituting lasting majorities. There were, however, ministries that last two and even three years as, for instance, the second Ferry ministry and the Méline ministry. But within the last 10 years this instability has disappeared in consequence of the Dreyfus affair and of the new division of the parties into two *blocs*, the radical-socialist and the conservative. The Waldeck-Rousseau and Combes ministries each lasted three years, the incumbents retiring voluntarily, the Rouvier two years, and the Sarrien is being continued with the same party under the Clémenceau ministry.

National sovereignty, acquired through universal suffrage and political liberties — such as those of the press, of meeting and of association — and a parliamentary régime, that is to say, the supremacy of parliament over the ministry, have become the groundwork of the constitution and of the political government of France.

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7. **France — French Socialism.** Socialism is an international theory. The same doctrine, the same conception of property, that is, is laid down by socialists in all countries. But every nation has produced its own form in the development of this doctrine, and these forms have been determined both by historical traditions and by the economic medium in which they have appeared.

Two traits have distinguished French Socialism from the rest. The first is that its character is strongly political, by which is meant that it is perpetually attempting to arrive at the government of the state, the second that it is continually animated by an active hope of immediate success in that effort. The French proletariat has (since the French Revolution) been mixed up with most of the decisive political struggles. It was the proletariat which dominated the Commune of Paris in 1793, and thus indirectly dominated the Convention. The French proletariat had, therefore, at the beginning of the modern period, already put its hand upon the central lever of the Revolutionary power. Somewhat later when the energies of the Revolution began to sink, it was among the populace, among the working people (who were already filled with the communistic spirit) that the vital forces of the Revolution were maintained; and the hopes which the proletariat entertained at that moment were of the most vigorous sort. Their programme at the close of the 18th century is summed up in the name of Babeuf. Babeuf did not look upon himself as the head of a mere party — it was in his character rather to despise party, because party always looks for its success to some chance hazard on the political field: it was rather his object to take up again the whole effort of democracy at the point where Robespierre (*q.v.*) had left it, and to widen it beyond the limits which Robespierre had assigned to it. It was his object to free those energies of the Revolution which had been captive since Thermidor. Babeuf believed the proletariat ready to assume and capable of assuming the responsibility of governing France, and had his conspiracy succeeded he would have changed the destiny of the country. The present writer has been told by a friend of Gambetta's that in his youth, when that leader had just come to Paris, he said freely «If Babeuf had won, the world would have been saved.» It would indeed have been saved from the counter revolution, from militarism and from the Napoleonic dictatorship, and a democracy which should have been based upon egalitarianism and alive with enthusiasm would have proceeded in peace to the organization of labour.

The note of all this is that at the very beginning of modern history the French proletariat had ceased to be «underground» as it were in the state. It thought itself strong enough for the highest tasks and it is this hope and this power of action which are continued obscurely or brilliantly in France throughout the whole of the 19th century. The proletariat recovered these hopes of theirs and put them forward again in a lively manner during the «Days of February» in 1848, on which occasion it was a socialistic inspiration which, for a moment at least, was the driving force of the second revolution. Even the terrible reprisals of June did not destroy the historical pride of the French proletariat. The day after the disaster it restated its leading idea and regathered its strength. Proudhom, in the book which he dated from the Prison of the Conciergerie in July 1851, defied the reaction to proceed to its logical end. «*The Revolution,*» he says, «*is at the present moment so thoroughly consummated in the national thought that to pass from thought to action is but a matter for executive energy. It is too late to avoid its power. The Revolution wills to be, and for her to will to be is to will to reign.*» The Bonapartist coup d'état was the object of this peculiarly audacious expression, and it had the effect of raising the proletariat once more to a conquering height in politics. The same hope, the same ambition permeated the days which elapsed just before the fall of the second Empire. Throughout 1868 and 1869 public meetings were the medium where the communist or the mutualist put forward the socialist doctrine with the utmost strength. The middle classes, especially the middle classes of the republican stamp, held aloof and affected to despise such programmes as «utopias,» but in the midst of their disdain the revolutionary working men were planning to lay a hand upon the new régime which was so soon to appear. Among Blanqui's papers, notes have been found upon the rôle which the proletariat would presumably play in the Revolution which he saw to be imminent. Had not the war of 1870 cut into these plans and had not the Empire fallen under that particular blow it would, without the slightest doubt, have fallen a few years later under the blows of a Revolution in which Socialism would have had a very large part. The attempts which were made during the siege of Paris by the Blanquistes on the 31 October, and which later developed into the Commune, would have dominated the new government or at least would have been very largely represented in it. There was even a moment when the republican part of France hesitated between the Commune and Versailles, and once again at that moment the French proletariat might have thought itself upon the eve of obtaining power.

It is evident that a working class with traditions of this sort and with an education of this sort is essentially political. It is evident that such a class will be acutely sensitive to political events, will be ready to watch them upon all occasions, and to seize every chance of penetrating into the very heart of the state and of there establishing its sovereignty.

Nevertheless a man might have asked himself after the Commune whether the socialist idea had not been buried. Superficial observers believed it to be dead, or at least laid for a long time. M. Taine expressed that thought clearly, standing with some friends before the wall where the prisoners had been shot in Père la Chaise: he said, «We are rid of Socialism for half a century,» and M. Thiers in his electoral manifesto of 1877, during the great struggle of the Republic against reaction which is known as the «Seise Mai.» boasted that he had finally crushed «the insane doctrines.» It is true to say, moreover, that Socialism then seemed doomed. The foremost of its fighters had been thrown down by the reactionary government of Versailles, they were transported or they were weary of the fight, or they were forced to fly the country. The people no longer so much as heard the distant voices of the exiles.

It must not be imagined on this account that the French proletariat, which had refused to give up hope or to cease a moment from its effort after the days of June 1848, had lost its ideal after 1871.

What had happened was that the working people of the country were now absorbed by another battle which though it was not fought in the streets was not less tragic than a civil war. This battle was the struggle between monarchy and republicanism. The French proletariat at this moment had the foresight to perceive that before it could raise the socialistic flag again, the republican battle must be won, and therefore, under the appearance of a mere constitutional struggle, a class war arose which lasted until 1877. The point of the struggle was to determine whether France should be governed by an oligarchy drawn from the remains of the old régime, an oligarchy of which the Orleanist and clericalized middle class were the nucleus, or on the contrary by an artisan democracy. But this class war, embroiled and intricate as it was, did not suffice for the socialistic idea once it was thoroughly awake, and the proletariat was but waiting for the defeat of the counter revolution to bring forward the social question and to force it upon the victorious republican party. Just after the Republican elections in which the country replied in October 1877 to the challenge of the reactionaries, Guesde and his friends began their revolutionary and collectivist campaign in their newspaper L'Egalité. The moment marks a decisive date in French socialism.

The first number of this journal appeared on 1 Nov. 1877. The very greatest difficulty confronted the leaders of the movement. In the first place the resistance of Marshal MacMahon and of the survivors of the coup d'état had not yet ceased and the socialist party had to defend itself against the accusation which the Republicans brought against it of creating a diversion in the midst of the struggle. «L'Egalité replied to these calumnies and to the treacherous insinuations which accompanied them by exactly defining its republicanism. It used the following words:

«The appearance of this journal in the midst of a political crisis does not arise from the fact that its founders are under any illusion as to the objections which would be made to them by the Republican party, objections of which the last speech of M. Jules Ferry has given us a foretaste. The moment in which we appear has been said by those who are too honest to calumniate us to be ill chosen. To this we reply that we have not chosen the moment. Week after week our first number has been put back in the hope that the will of the country as it was expressed on the 13 October would have been put into full execution. It is not our fault if the delay in radical reform has been caused by the struggle between a small clique against the whole nation.

«We might further ask whether in the opinion of Republicans who blame us any moment whatever seemed well-chosen for attacking the economic privileges of their class, and we defy them, if they are indeed sincere, to reply in any affirmative manner.

«The only men who have the right to attack us in the matter of our publication are the working men, whose organ we desire to be, and upon that side we are quite at our ease. The working class have too clear a conception of their interest not to understand that the moment just before a battle is the very moment when it is the most essential not to leave the liberal middle classes in any doubt as to the nature of the help which we are willing to give them against a common enemy. The moment before the battle is also the moment for proclaiming in the strongest manner that it is not the business of the working classes to be perpetually pulling the chestnuts out of the fire for professional politicians, but rather to clear the only ground upon which their claims can be successfully established. And that ground, of course, can only be a republican republic.»

Another formidable problem arose before the organizers of socialism at this time — that is 1877. What should be their attitude toward universal suffrage? Should they despise it or should they use it? Up to that date universal suffrage in France had always appeared as an instrument of reaction. It was under the heavy weight of the peasantry that the Empire had crushed the republican and socialist thought of the towns. Hardly had that thought been relieved somewhat by the revolutionary forces of September and the fall of the Empire than France was again given up by universal suffrage to the reaction, to the country squires and to the fanatical clericals of the assembly at Versailles. But universal suffrage was destined bit by bit to be enlightened and to emancipate itself. The republican idea alone had had the strength to liberate the country from the assembly at Versailles. Universal suffrage had (again through the republican idea) found the strength to break the counter revolutionary attempt on the 16 May 1877. To despise universal suffrage and not to take advantage of it would be to remain outside the national life. To have done so would have been to reduce the socialist to an anarchic and powerless sect. Guesde and his friends accomplished a decisive act and rendered the French proletariat a vast service when they decided to rely upon universal suffrage, for by this decision the proletariat entered into the main current of the national life. They did not expect democracy would of itself achieve the socialization of property. They believed that only revolutionary violence would succeed and that the proletarian revolution would have to be accomplished by force, as every other revolution had been accomplished, and as more recently in the United States had been accomplished the abolition of slavery. But by relying upon universal suffrage they changed the nature of the class struggle, they took it out of the workshop and brought it into the large world of politics. It was decided that the proletariat should choose men who would represent their class when they should send into parliament men who had no idea of needing a majority there, but who could without ceasing act upon and render anxious the capitalist régime.

The plan was to cast upon that régime so implacable a light that in its exasperation and bewilderment a social revolution far more systematic and far more thought-out than the Commune should at last push capitalism to its last entrenchments and make it deliver a decisive battle. The resources of universal suffrage were for Guesde and his friends only the prelude to an active revolution. What might be called the historical ambition and the historical habit of mind of the French proletariat was awake. It thought itself now as ever on the eve of a final assault and believed that it might enter into the government of the state by some unguarded door, and in its turn become master where the other classes had reigned. From 1877 to 1893 this was the attitude of mind of the French socialists whether they were the friends of Guesde or Blanquists, whose leader Vaillant had been brought back from exile by the recent amnesty. In the same tone of thought were journalists who, like Allemane, represented the Parisian proletariat. The great electoral successes of 1893 which suddenly introduced into the Parliament a body of 40 socialists brought this excitement to a head, and the more enthusiastic of the party were justified in believing that the proletariat had at last reached the goal of their effort. The Republican and the middle class parties, worn out by the long and continual struggles between the opportunists and the radicals and broken by the Panama scandals, seemed condemned to impotence. Guesde believed their régime to be in its death throes, and he thought that the moment had come to turn democracy away from what was now no more a corpse. The socialistic minority needed nothing more than ability and courage in his opinion to become the leading majority, and universal suffrage would vote socialist if only an active and wide propaganda could be inaugurated among the peasantry and the smaller tradesmen, to prove to them that their personal interests lay in an alliance with the industrial proletariat.

It was at this moment that Guesde addressed to the bourgeois parties in the Chamber, the phrase: «We need use no weapon against you but those which you have provided for us in your own legal forms.»

It will be seen that by this time the tactics founded in 1877 had changed. But the same hopes and the same courageous spirit of action permeated the socialist proletariat. These hopes undoubtedly contained an element of illusion, but they were not all illusion. The political efficacity of socialism was rapidly growing and although the results had not given the socialist proletariat the full victory for which it had hoped, it nevertheless kept the activity of the party and its general spirit alive. Even when, after 1898, the socialist party had to give up the hope of an immediate and final success, it none the less retained the knowledge that it had become an historical force of the first order and one capable of playing a decisive part in the national life. It is this result which, when one eliminates the details of the struggle, remains the chief fact in the participation of socialists in the defence of the Republic under the Waldeck-Rousseau ministry, and the participation which the party also took in the work of laïcal emancipation under the Combes ministry. The traditional thread which unites the action of the French proletariat is perpetually showing itself in new forms which arise for the momentary necessities of the Republican democracy and the Parliamentary régime. At the present moment the «parti socialiste uni» is withdrawing itself from the parliamentary system of groups and especially from those which aim at the forming of a ministry, but it is not so withdrawing itself in a sort of contemplative solitude, neither is it so withdrawing itself because it has given up hope of some ultimate decisive action. It is withdrawing itself because its leaders have discovered that the moment had come to rally to itself the general conscience of the whole working class and it could not do so without further propaganda. When that propaganda shall be completed, it will be able to throw all its forces into the general movement of politics without in the least abandoning its ideal. In the first great crisis whether interior or exterior that may shake the troubled modern life of France the Socialist party will throw itself into the centre of the struggle and it will be driven forward by the indomitable and compelling hope which its history has taught it.

So true is this that even those of the French proletariat who imagine themselves to be divorced from political action, are, if their methods be closely watched, only seeking some new form of action which shall be more political. What is known in France as "La Syndacalisme," that is the Trade Union movement which pretends to stand aside and to be able to despise electoral and parliamentary action, is at bottom an essentially political thing. When the leaders of this movement put it forward that a general revolutionary strike may compel the world to a communistic form of production — to put forward such a theory is to inaugurate an action that is, at bottom, definitely political. It would be an error therefore to think that the newer movements in French socialism are an abandonment of the chief political method or a delaying of it. They are rather an emphatic assertion of it, an exaltation of that certitude in the political future which we have called the defining character of Socialism in France.

This note of hope, however, which has been so frequently mentioned in this article would be but a sort of madness if French socialism were to count upon the industrial worker alone. For the industrial development of France, though in the last 50 years it has been accelerated, is relatively far less than that of England, Germany or the United States. France is still largely an agricultural country, and if Socialism were to retain as enemies against itself the 19,000,000 of peasants, nay more, if it did not draw them in the wake of its ideas, it would break itself against an insurmountable obstacle. It is on this account that the party has attacked the problem of converting the peasant. The French Socialists know very well that the millions of peasant proprietors will never allow themselves to be expropriated by law. The party has put forth all its efforts to persuade the small proprietors that no such agrarian communism is in view. The theoretical formulæ which have here arrested the development of German socialism have not weighed upon the French party. It is the opinion of the leaders of that party that the peasant proprietors will bit by bit enter voluntarily into a state organized upon the socialistic basis and this is the future that far-seeing men like Blanqui believed to be nearer than in the event actually proved to be. It is this process of gradual and voluntary acceptation of the collectivist state by the peasant proprietors which Guesde foresaw in 1877 and put forward in his newspaper. «The French peasantry» he wrote «may rest assured that expropriation of their land would remain necessarily outside any programme for a collectivist organization of the great industries or of large landed property.» Blanqui also had laid it down as a doctrine of tactics in the admirable notes which he drew up at the end of the Empire. He pointed out that the peasants of the country were permeated by revolutionary memories, that the peasants like the rest of the country had a tradition of hearty political initiative, that the peasants had given battle to the nobles and to the priests, and that the peasant had no love for the "fat bourgeois" who had taken the best of the lands. And Socialism he thought based upon these traditions and these memories would end by attaching the peasant to its movement.

In a word, one does not find in France any ineradicable conservative force nor any permanent trend of affairs which can oppose itself to the action of socialism. The Socialist party has such certitude of this that the future seems assured to it.

It remains to add that French socialism, though perpetually attaching itself to party forms, can never permanently attach itself to such forms. It looks to a revolutionary and decisive achievement and bases itself upon a sort of national habit of revolutionary action. It is not to be imagined that this formula, however true, means that French socialism can in the future detach itself from the universal suffrage which governs the country, nor must it be imagined that it can develop its nature apart from the creed of democracy, which is part and parcel of the French people. But when one says that its character will remain essentially revolutionary and attached to the traditions of rapid political action one means that the French Socialist party will, like its predecessors, be perpetually and rapidly choosing from the mass of political events such a congeries as may be used for producing the maximum effect at the critical moment of a struggle, and that, like every other French party of the past, it will continue to reject compromise and to attempt nothing less than the full success of its clear and definite enterprise.

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8. France—Church and State.* *Under the Ancient Régime.*—As early as the 6th century when the bishops became influential persons, the Frankish kings began to intervene in the episcopal elections and the two powers—civic and religious—were interdependent. No vital point in the doctrine being ever interfered with by the monarch, the bishops and clergy never found themselves in the necessity of withstanding him, and the Church remained for many centuries the councillor and auxiliary of the king. Throughout the Middle Ages the bishops and richer abbots were great «ecclesiastical lords,» and when the feudal system had made room for the royal supremacy, their order remained on the same level as the nobility and high above the Third Order. The kings of France, Saint Louis as well as Louis XIV. were jealous of the Papal power and carefully fostered in the clergy the national spirit known as «gallicanism» (q. v.).

But although the power of the clergy was so great, one ought not to imagine that their spiritual influence suffered no weakening in the course of ages. The literature of the Middle Ages is full of taunts against the Church, and the Protestant revolt of the 16th century was followed in the 17th by the sceptic spirit of the Libertins, and in the 18th by that of Voltaire and the Encyclopedists. The higher clergy were still a powerful aristocracy when, on the eve of the Revolution, the number of the faithful had dwindled ominously (15 millions out of 27 being only nominal Catholics), and the country clergy had imbibed the spirit of reform which was so soon to cause the great disruption.

The Concordat.—The schism brought about by the *constitution civile,* the banishments and executions made by the Terrorists, the latent persecutions carried on until 1798 and the lack of organization which prevailed during the next three years had left the Church of France in a sorry state, when Bonaparte, then First-Consul, felt in 1801 the necessity of making use of the religious element for his work of restoration. There were very few priests left, numberless churches had been pulled down, or neglected and out of repair, and nine-tenths of the ecclesiastical property had been confiscated by the government or sold and could not be reclaimed without difficulties of all kinds.

It was then that Bonaparte after several months' negotiations with Cardinal Consalvi signed the famous Concordat with Pope Pius VI. The main points of this agreement were the following: The Catholic religion and worship were to be protected by the State, and the clergy to be maintained by the Treasury (the bishops receiving 10,000 francs, and the parish priests 900 francs); in exchange for these advantages the Pope was to nominate no bishop without the consent of the government, and the property lost by the Church during the period of disturbances was to be given up forever. Later on some additional clauses of an aggravating character, known as *Articles Organiques,* were surreptitiously appended to the Concordat; all Papal documents ought to be submitted to the *Visa* of government; the bishops were forbidden to travel out of their dioceses without permission; they might be tried and reprimanded or punished by the State Council; they had no right to hold assemblies between themselves, etc. This arrangement worked for a whole century without any serious hitch, but there were between the Church and the age deep differences which were inevitably to bring on a crisis. There was little real life in the Church. The clergy had been taught to stay at home and dread the worldly visit and they were carefully kept in ignorance of nearly all the scientific movements going on around them.

The only exception was the liberal group formed by Lamennais, Montalembert and Lacordaire, who advocated more freedom for the Church, even at the cost of disestablishment, and pointed out the resemblance between several principles of the Revolution and those of Christianity. But these forerunners of the Catholic democrats of to-day were not heard and the Church was content with the drowsy comfort of her situation. The governments of the Restoration, Louis Philippe, and Napoleon III. looked upon the clergy as a valuable assistant, and while keeping it under control allowed no attack against it. The power of the bishops had never been so great as in the first 10 years of the reign of Napoleon III. (1852-1862).

Meanwhile, an aggressive spirit of unbelief was rapidly developing, thanks to the stagnation of theology, and the success of Renan's works was not long in giving its measure. The politicians who favored the Church were not believers in Christianity. Republican proselytizing was active, too, when the greatest part of the clergy would still support the doctrine of divine right and prayed for a Bourbon restoration. The war of 1870 gave the Republicans their opportunity: the Republic was established, and an overwhelming majority of the clergy found themselves in opposition.

The Disestablishment.—The Concordat was not to be cancelled yet for more than 30 years, but its disappearance was spoken of as possible and easy, and M. Clemenceau never let a year pass without delivering some strong speech against it. He gradually spread a conviction that it was absurd for a democratic and anti-clerical government to maintain a clergy opposed to them and held in subjection by the Pope, *i. e.* a foreign ruler; that the tax corresponding to clerical salaries ought to be levied exclusively on practicing Catholics; and at last that the Catholics themselves would be freer when untrammeled from the state control. For nearly 30 years prime ministers in succession replied that the Concordat was a treaty and could not be cancelled without the Pope's consent; that clerical salaries were part of the public debt, and last, that it was not advisable to give complete liberty to the Church.

In the year 1890 Pope Leo XIII. wrote to the Catholics of France the famous encyclical advising total and sincere loyalty to the Republican government and discouraging the monarchic hopes of the old parties. The younger clergy, who for some years had been republicans at heart, welcomed the Papal letter as a chart of enfranchisement and for a few years the situation seemed altered. The spirit of loyalty gained ground every day among the Catholics, and anti-clericalism was decreasing; for a few years the «new spirit» which M. Spuller had proclaimed in a famous speech really prevailed.

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* Clerical view.

The Jesuits whom Jules Ferry had expelled in 1880 had nearly all come back and filled their old colleges. Most of them were royalists. On the other hand the Freemasons had resumed their anti-clerical campaign, and their influence in Parliament being very considerable, they succeeded in passing several Acts (loi militaire, loi d'abonnement, laicisation des écoles, loi surla comptabilité, des fabriques, etc.) which the Catholics could but look upon as molestations.

The French Free-Masons (Grand Orient of France) differ widely from their Anglo-Saxon brethren. They are above all a political body, strongly tinged with Socialism and so averse to spiritualism and theism that the name of God has been struck from their rituals. They are purely materialistic and aim at nothing short of the total elimination of religion from the body politic.

The last two years of the 19th century were almost entirely occupied by the Dreyfus affair (q. v.). The Catholic papers, especially the *Croix,* showed their anti-semitism in a stupid and shocking manner, and it can hardly be doubted that the increase of anti-clericalism in the following years was mostly a reaction against it. The government of M. Combes was only a long persecution with a dangerous forgetfulness of many vital interests at home and abroad. Its chief act was the expulsion of the religious orders and the confiscation of their property in disregard of the law passed by M. Waldeck-Rousseau. In 1903 President Loubet went to Rome on a visit to the King of Italy and ignored the Pope. Such conduct was considered by the Church hardly reconcilable with the presence of an ambassador to the Vatican. The Pope complained in a circular sent to every Catholic government, whereupon the French ambassador was recalled and all intercourse with the Nuncio suspended, and disestablishment became a certainty in the near future. In fact, the Separation Law was passed by the Chamber in June 1905 and by the Senate in December of the same year.

The main lines of the Act were as follows: The French government ignored the Church as a religious body, and only recognized associations formed according to the law of 1901. These associations were to consist of seven to 25 members who would represent the parish. To these associations the places of worship should be left free, but with the heavy burden of keeping them in repair. The rectories, bishops' palaces, and seminaries should be regarded as state property and taken back from their present owners within five years. The Public Worship Budget was suppressed and the priests were to depend for their maintenance on the associations. The latter were entitled to civic rights, but their property was not to exceed the limits of their needs and their accounts were to be yearly looked into.

The majority of the French Bishops were for submitting to the law, but the Pope, considerably influenced — as was demonstrated through the Montagnini papers—by a few laymen of monarchist and conservative tendencies, vetoed the formation of associations and rejected each successive *modus vivendi* proposed by the French government, so that there is neither a legal status for the Church nor complete separation. The possession and use of the places of worship constitute the last bond. All churches are legally municipal property, but ought neither to be denied to the Catholics nor used for other than religious purposes. On the whole, the Church of France never enjoyed as much freedom as at present, but she never was so utterly destitute. See CHURCH AND STATE.

ABBE ERNEST DIMNET.

9. France—Church and State.[*] At the outbreak of the Revolution of 1789, the Apostolic and Roman Catholic religion was the religion of the State, and, since the Revocation of the Edict of Nantes, no other religious sect, Christian or non-Christan, had had any legal existence in France. Nevertheless, a royal decree two years before had granted a sort of tolerance and legal status to the Protestants. The king had likewise allowed the Jews to live in certain cities in the kingdom, and there to carry on their worship in private: a régime of tolerance, not of freedom of conscience. The relations between the king and the Pope were determined by the concordat concluded in 1516 between Francis I. and Leo X.

The men of the Revolution had no intention at first of secularizing the State or of separating it from the Church, nor even of establishing any real liberty of conscience. The Declaration of Rights of 1789, granted, in fact, only tolerance, and it was not until the 27 Sept. 1791 that the Constituent Assembly placed the Jews on a similar footing with other citizens. While it confiscated the possessions of the Church, it nevertheless tightened the bonds of Church and State by means of the law entitled the «Civil Constitution of the Clergy» (12 July 1790). This gave to the clergy a salary from the State, by which the parish priests especially profited, and this first budget of the Religions rose to about one hundred million francs. As a consequence and climax of the Gallican policy of the kings, the Civil Constitution of the clergy tended to make the Catholic religion national. Thenceforth the bishops and the priests were elected by the people; the bishops no longer received from the Pope their canonical institution; it was given them by another bishop. The newly elected clergyman could not address to the Pope any request for confirmation; he had to confine himself to writing to him, as visible head of the universal Church, in testimony of unity of faith and communion. Thus without any diplomatic notification, the concordat of 1516 came to an end.

But the Catholic religion continued to be the religion of the State, and no salary was allotted to the ministers of other creeds; it was thought that enough was done for them in leaving them undisturbed. Such were the events which, little by little, led the Revolutionaries to loosen the bonds which united Church and State. The Pope, after much hesitation, condemned the Civil Constitution, and the clergy divided into two factions whose numerical proportions are not well known. Those who accepted the Civil Constitution and took the oath it demanded were called *Constitutionals*, or *Assermentés;* those who in obedience to the Pope refused the oath, were called *Refractories.*

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[*] Anti-clerical view.

There were thus a Papal Catholic clergy and a non-Papal Catholic clergy whose partisans quarrelled for the possession of the churches almost to the point of civil war. The inclinations of both parties alike were adverse to the liberty of sects; but most violent objection to such liberty was made by the papal clergy, who had become an opposing minority. The Constituent Assembly with very ill grace finished by granting the principle of it by the law of 7th of May, 1791, which authorized the Papal party to carry on their worship in the churches in concurrence with the non-Papal party with reservations and irksome restrictions. This was to some extent a recognition and consecration of the existence of the schism, but the people, attached to the idea of religious unity, had no wish for any schism. Consequently, in one part of the country the Papal clergy, in another the non-Papals were harassed; and continual religious disturbances took place during the years 1791-2. It was the recognition of this situation which inclined many enlightened Frenchmen to the then very unpopular idea of the separation of Church and State and the secularization of the State.

Even the National Convention, which passes in history as an assembly of atheists, put aside at first, in Nov. 1792, a project of separation, and formally maintained the Civil Constitution, limiting itself to making laws against refractory priests. But soon, when the Republic had replaced the monarchy, all the Catholic clergy became unpopular. The patriots accused the Papal clergy of conspiring with outside enemies and with the *émigrés,* and also of fomenting the Civil War in the province of la Vendée. They accused the non-Papal clergy of having taken part in the Civil War of the Republic with the Girondins against the party of the Mountain. It seemed to the people that all the priests, Constitutionals or Refractories, were conspiring against the Revolution, and that they were a permanent danger to the Republic. Although the people had not become philosophers, they had the feeling that to put it out of the power of the priests to harm the country, they would have to tear down their altars; and it was thus, much less by philosophy than by patriotism, much less by anti-religious fanaticism than as an expedient of national defense; it was thus, I say, that there arose these popular disturbances which finished by taking the form of an attempt at the dechristianization of France. There was first the cult of Reason, with which the Convention was associated only to a limited extent, principally in permitting the communes to renounce their worship. Through its Committee of Public Safety it strove to prevent violence against persons; it proclaimed the principle of liberty of conscience. But passions were stronger than the laws or the Government. One after another most of the churches were closed and the observance of religious worship was pretty generally suspended in 1794.

A new attempt at a State religion was made the same year by the efforts of Robespierre, who was then the true head of the French government; this was the worship of the Supreme Being, a sort of philosophical religion or purified Christianity, which disappeared entirely, or almost so, when Robespierre died.

Then, when the victories of the French had put an end to the terror which the coalition of priests and foreigners had inspired, the Catholic religion spontaneously reappeared. Then at last, enlightened by experience, waiving all idea of a State religion, the National Convention established the secular régime of separation, which lasted from the end of 1794 to the spring of 1803. Under this régime the State paid no further salaries to any sect, and all the sects, equal before the law, worshipped freely, with the provisional restrictions and the police precautions rendered necessary by the state of foreign and even civil war in which France still labored. A number of the churches were restored to purposes of worship, on condition that the priests who should enjoy the privilege should submit to the laws. Nevertheless, there remained a shadow, a trace, of a State religion; this was the «*culte Decadaire*» or «Ten-Days» religion, a sort of official religion of patriotism, which disappeared little by little under public indifference, when the country was no longer in danger. On the other hand a new religion arose, a kind of unofficial continuation of the cult of the Supreme Being; this was Theophilanthropism.

Papal Catholics, non-Papal Catholics, Jews, Protestants, Theophilanthropists, adepts of the ten-day cult; all these sects acted as counterpoise to each other in a state of liberty, and although the vicissitudes of foreign and civil war brought on acts of intolerance, it may be said that the régime of separation of Church and State became a part of the life of France at the time of Consulate, that it was at least endurable for all sects, and that there was a rich development of religious life.

If Napoleon Bonaparte suppressed this régime of liberty, at which he had himself presided with as much success as talent; if he came at last to desire and to effect the reunion with Rome, to conclude a new concordat, it was not at all from piety but from personal ambition, his purpose being to command, through the Pope, the consciences of men, to realize through the Pope his dreams of power and of universal empire.

When the victory of Marengo had made him sufficiently popular to believe that all things were permitted to him, in the enforced silence of public opinion and the press, he entered upon negotiations with the Pope, and on 15 July 1801, at Paris, an act was signed which, since none dare call it a concordat, was called a Conversion, but which was really an agreement analogous to that which Francis I. had concluded with Leo X. In it Catholicism was not declared the religion of the State, but the fact was recognized that it was the faith of the great majority of the French people. The Pope was to demand or force the resignation of all the bishops then acting, and after a new circumscription of dioceses had been determined on, the First Consul was to make nominations to these bishoprics or archbishoprics, and the Pope was to confer on the persons thus nominated, canonical ordination according to the forms of the earlier concordat. The bishops should nominate the priests, but subject to the approval of the government. The Pope promised that the purchasers of property formerly belonging to the clergy should not be disturbed; and a suitable salary was to be given the bishops and priests by the Government. On the other hand, the First Consul instituted some regulations of policy, called the Organic Articles, by which he received security from the churches, in conformity with the ancient Gallican policy. The Conversion and the Organic Articles became law on the 18 Germinal, year 10 of the Republic (March 1802) and the new concordat was in force from the end of the following April.

The greatest advantage that accrued to the Pope from this document did not appear in writing: this was the suppression of schism. Bonaparte abolished the heretofore constitutional church. He abolished also Theophilanthropy and whatever remained of the «Tendays» worship. Protestants and Jews were recognized and protected by the State, but not with the same degree of honor and influence. The Concordat promised salaries only to the district priests. When Bonaparte became emperor, he allowed a salary to other priests or curates to the number of more than thirty thousand. The budget of Religions swelled little by little. At the time of the rupture of the Concordat, in 1905, it was about fifty millions of francs.

Pope Pius VI., who had signed the Concordat, came to Paris in person to consecrate the new Emperor, but Napoleon did not find in him the docile tool he was counting upon. Not being able to bend him to every whim of his despotic will, he used force, had him carried off from Rome and kept him a prisoner at Fontainebleau, thus provoking the wrath of the Catholics and bringing upon himself the hatred of all religious persons.

It was in hatred of Napoleon, likewise, that Louis XVIII. planned to make a new concordat more favorable to the Church. This concordat was, indeed, drawn up in 1817, but it was not carried out, and it was the concordat of 1801 which governed the relations of the Catholic church and the State up to the beginning of the 20th century. The charter of 1814, while guaranteeing the freedom of conscience, declared Catholicism as the State religion. This declaration was from the charter in 1830, and the government acted from 1815 to 1905 in the direction of a real liberty of the sects, at least of those recognized by the State: for no legal guarantee was granted to the founding of new sects. On the whole, although some of the liberal party, from the time of Louis Philippe demanded a return to the régime of the separation, the regulations of the Concordat acted without encumbrance and seemed to suit the state of public opinion in France up to the end of the 19th century.

After the promulgation of the dogma of Infallibility, the Catholic Church, now an entirely absolute monarchy, appeared a menace to civil society; especially when the suppression of his temporal power had made the Pope invulnerable. On the other hand, since the loss of Alsace-Lorraine separated from France a large number of Lutherans, Catholicism had no longer any rivals but the Jews, who do no proselytizing, and the Calvinists, who do very little. In the years which followed the Franco-Prussian war, the Catholic clergy showed a desire to govern France and even to plunge her, all shattered as she was, into the perils of a war for the restoration of the Pope's temporal power. The same clergy favored the two attempts at political reaction by Marshal MacMahon. Thus the priesthood lost its popularity. Soon the primary schools, now a lay institution, enfeebled religious faith in France, and free-thought made great strides. Every year in the Chamber of Deputies, lively opposition was made on the vote on the budget of Religions, and the separation of Church and State was demanded in a considerable number of Electoral programs; but there was, nevertheless, no strong popular movement in this direction. Even the Chamber elected in 1902 seemed determined to maintain the Concordat.

An unlooked-for incident changed the situation. In the spring of the year 1904 the president of the French republic returned the visit which he had received from the King of Italy, and moreover returned it at Rome. The Pope, who still claims the sovereignty of his ancient States, declared himself insulted by this proceeding, and addressed to all the Catholic Powers a document in which he complained of the offence committed by the French against his rights and his dignity. This memorandum, when made known, deeply wounded the national sentiment of the French. The government of the Republic recalled its ambassador from Rome and returned to the Papal nuncio his passports. There was a complete rupture of diplomatic relations between France and the Pope, and on 10 Feb. 1905, the Chamber of Deputies, by a majority of 386 votes against 111, declared «that the attitude of the Vatican rendered necessary the separation of Church and State.»

The writer of the project of a law of separation was M. Aristide Briand, Socialist Collectivist, a man of character more moderate than his opinions. He strove, by skillful combinations, to prepare a régime that would be acceptable to the Church, but there were no negotiations, official or direct, with the Pope himself. The Briand plan received, in the course of debate, but few amendments.

The whole bill was passed in the Chamber of Deputies on 3 July 1905, by 341 votes against 233, and in the Senate, on 6 Dec. 1905, by 179 votes against 103. The law was declared 9 Dec. 1905. It forms to-day (1907) the politico-religious system of France.

The particulars of the law are these: the Republic assures liberty of conscience, and guarantees the free observance of religious worship; it does not recognize nor pay nor subsidize any sect. All public religious establishments are suppressed, revenues, factories, councils of elders, consistories and the like. The property of these establishments will be transferred to associations called «cultuelles» to provide for the expenses, the maintenance and the public observance of a sect, and composed of a minimum of 7, 15, or 25 persons, according to the population of the community. The church buildings which belong to the nation (and this means the greater number) will be left free of charge at the disposition of the religious societies, who will be held responsible for repairs of all sorts. Life pensions are granted to ministers of religion of more than 60 years of age and actually in service; those less than 60 years old will receive an allowance for four years. As to the police regulations of the sects, the meetings are public, but take place under the surveillance of the authorities in the interest of public order. Penalties are enacted against such ministers of religion as shall make in the churches any extreme political opposition to the Republic.

The Protestant and Jewish congregations submitted without difficulty to this law, but such was not the case with the Catholic Church, or rather with the head of this Church. The majority of French bishops, in assembly at Paris, agreed to accept the law, after a formal protest, and to organize under the name of Canonical Associations, societies analogous to those the law recommended. There even seemed to be a sort of agreement established between the clergy and M. Briand, who had become Minister of Public Instruction and Religion, and who had charge in this capacity of the administration of the Law of Separation. Moreover, the most eminent of the Catholic laity, the Catholic «Intellectuals,» had publicly advised the Pope to accept the law. The Pope preferred to follow the advice of the Jesuits, who urged him to an uncompromising resistance. He believed that the formation of religious societies would bring democracy into the Catholic Church in France, and from that the destruction of the monarchical hierarchy of the Church would some day result. Not only did he condemn the law but he forbade the formation of the religious societies or anything that resembled them. The French bishops were dismayed, but they obeyed the Pope.

There seemed reason to fear a religious civil war. Already at the beginning of the administration of the law, when the government wished to make an inventory of articles of furniture kept in the churches, the Catholics had forcibly opposed the officials in more than one place, and in some conflicts blood was shed.

This time the government pushed prudence to the point of negative passiveness. It allowed the Catholic priests to continue their services in the churches of which they already had possession, and to this day they keep this possession under provisional title with no legal right nor guarantee. There has not been any religious disturbance in any part of France since the Pope rejected the law. Some of the Catholic laity tried by a sort of schism to form religious associations in defiance of the Pope's orders; their attempt fell flat, in the face of public indifference.

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10. **France—Education**
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ber of colleges, and after the great revival of learning at the Renaissance, the latter multiplied so, that in Paris alone, there were more than 50 of them. As to the universities, they, too, steadily increased, and when the Revolution broke out in 1789, there were no fewer than 25 in France, Paris being the most important with 6,000 undergraduates. But so far, little had been done for the education of the people at large, and learning had remained the portion of an «élite.» Primary instruction was given in small uncomfortable schools by masters not often qualified for their task: teaching the rudiments was looked upon as a trade, and the customers were few, because few were able or willing to pay. Yet a universal feeling prevailed throughout the kingdom that this state of things was to be remedied, and when the «Etats généraux» summoned by Louis XVI. assembled in Paris, there was a loud cry from the third estate and the clery for better schools and a wider diffusion of instruction among the people. They distinctly asked for a national education of all classes, by means of national schools. But the expense entailed in the execution of such a vast scheme was obviously too much for the public treasury, exhausted as it was by continuous war. «The Constituante» adopted the principle, but two years later when the members of the «Legislative» were asked by Condorcet for 24,000,000 francs as a first outlay, they were obliged to reduce the estimate to a paltry 200,000 (29 May 1792). In spite of repeated discussions in the assembly concerning the opportunity of making education compulsory, and of several decrees trying to enforce its decisions, nothing really effective could be done for the time being. The first practical measure was taken by Lakanal and the «Convention» (27th Brumaire year three) when they granted a subsidy to the primary schools then extant, and created training schools to recruit masters. This was but a very imperfect solution, and one that only partially met the wishes of the people, but it was the greatest effort made by the Revolution to solve the problem of a national primary education. More was attempted in favor of secondary education, which received a common programme of studies combining scientific with classical training, and for which the act of the 7th Ventose year three established the so-called «central schools.» A new plan of secondary education, drawn up by Napoleon, then first consul, with the help of Fourcroy and adopted by Parliament (1 May 1802) brought up to 36 the number of the central schools, which took the name of «lycées» and which were provided with the necessary staff of masters and an effectual budget. And it was only the beginning of a vaster scheme, for in 1808, when he had become emperor, Napoleon with a view to forming a young generation devoted to the Imperial régime, founded the Imperial University, «exclusively entrusted with the mission of teaching and giving education in the whole Empire.» It was a complete organization of education in three degrees, elementary, secondary and superior, placed in the hands of a privileged corporation, which, in the intention, at least of its founder, was destined to abolish private education everywhere and in all its forms. This total abolition, of course, was as yet impossible; so private colleges were tolerated, but only under the control of the omnipotent University and with the main object of recruiting pupils for it afterwards. Moreover, of the national primary schools that were so badly wanted, few, if any, were created; Napoleon's University merely adopted and, so to speak, legitimated those which existed already. Guizot in 1833 for the first time seriously took in hand the interests of popular education; under his influence the primary schools increased in the proportion of nearly 900 a year (24,000 in 1847, against 9,000 in 1830).

However, it belonged to the Third Republic to achieve the task conceived by the Revolutionaries of 1789, unsuccessfully attempted by their successors and only begun by Guizot himself. In 1882 Parliament adopted Jules Ferry's famous education bill that rendered primary instruction compulsory and gratuitous. Nor was its interest limited to the more elementary and democratic form of knowledge, all the departments of education were infused with a new life: 800,000,000 francs (£32,000,000 sterling) were spent on new buildings including Faculties and Lycées as well as schools, and the annual educational budget was raised within 30 years from 44,000,000 francs to 210,000,0000 francs.

These figures, of course, must be understood to represent the share of the State only, not the total of the expenses connected with education; besides the national schools and faculties, there exist a very large number of private institutions, of which further mention will be made.

II. *Organisation of National Education.*—The modern «University of France» is still to some extent organized as was Napoleon's «Imperial University»; only it is no longer, as it was then, an independent corporation. Since the creation of the Ministry of Public Instruction by Charles X. (26 Aug. 1824), it has been administered directly by the State, as the other great public services. The supreme authority is officially in the hands of the Minister of Public Instruction, who, however, is helped in his decisions by the directors of the three departments of superior, secondary and primary education, and more effectually still by several deliberating assemblies of professors and officials, the most important of which are the University Council and the Committee of Public Instruction. As direct representatives of the central power, 15 *rectors* residing in the 15 university towns have the supervision and management of all educational matters in their academy (or academic province). Each academy possesses also an assembly of professors elected by their colleagues, the Academic Council, in which are treated pedagogical and administrative questions interesting the academy. Under the rector are placed *Academy Inspectors*, who have the care of secondary and primary instruction, and under them again *Primary Inspectors* who superintend the primary schools.

Thus the three different branches of education are grouped into one vast administrative organism, insuring their homogeneity and the necessary unity of direction. Each of them, however, being destined to meet distinct and separate wants and consequently being managed on a distinct and separate plan, it is necessary to view them each by itself.

Primary Education is compulsory for all children from 6 to 13: those who do not attend the government schools (where it is gratuitous), are obliged to prove that they receive proper tuition either in a private school or at home. The matters taught are reading and writing, orthography, composition, arithmetic, the elements of natural history and natural philosophy, history, geography, drawing and singing and also gymnastics for boys and needlework for girls. At the end of their regular course of studies, those of the pupils who want a more substantial and wider instruction, and yet do not choose to go to a lycée or a college, may get it in one of the 350 «superior primary schools» created within the last 25 years, or attend the so-called «complementary lectures» where superior schools have not yet been established. This «superior primary education,» which in some points is like a sort of cheap secondary education, has, however, a more practical and positive object than the latter and is better suited to the wants of the working and commercial classes. For such of the young men or girls who cannot spare the time to complete their studies in superior primary schools, there exist in all towns and in most villages, evening classes, which, it is true, are due to the masters' own initiative, but which at the same time are officially recognized and encouraged by the academic authorities.

Everyone possessing the necessary diplomas may apply for a post of master or mistress in a primary school; but the government, understanding that good teaching can only be given by well trained teachers, has provided in each department two training schools, one for girls and one for young men, in which the future masters and mistresses are kept and educated for three years at the expense of the State. School-masters and mistresses are appointed and promoted, not by the minister, as is the case for the professors of the other two degrees of education, but by the prefect in each department, with approbation of the Academy Inspector.

Secondary Education is given to the boys in 106 lycées and 246 colleges. A lycée is properly a public school, being the property of the State, kept and administered by the State; whereas a college is a municipal institution. In both the professors are appointed by, and placed under the authority of, the Minister of Public Instruction; in both also the matters taught are the same; yet there is a difference between them as regards their respective importance, the average number of boys in a lycée being 500 to some 200 in a college; and instruction in the former being generally recognized as of a higher standard. In a lycée the masters are divided into two classes: the «agrégés de l'Université» (*i. e.* fellows) who hold a regular professorship, and the licenciés (M.A.) who are simply «chargés de cours» or lecturers. In a college the professors are only licenciés.

Within the last 15 years the secondary curriculum has been repeatedly modified: originally it comprised only two parallel courses of study, of which one was chiefly classical and the other chiefly scientific. It has now become more complex: the division in two sections is kept through the lower forms up to the third, after which the boys have to choose between four sections according to the «specialties» they think will be most useful to them in after life. These specialties, which are part of the staple of secondary education, are coupled into four groups: (1) Latin and Greek; (2) Latin and Modern Languages; (3) Latin and Sciences; (4) Sciences and Modern Languages. At the end of the first form, generally at the age of 17, the boys undergo one of the four examinations corresponding to the section to which they belong, and then spend one year more in the study of philosophy or of the more advanced mathematics, after which another examination (the second of the «baccalauréat») successfully passed gives them the title of «bachelier,» the official conclusion and stamping of secondary education, the possession of which is necessary for most liberal professions, and absolutely requisite for admission in the Faculties.

Up to 1881 the State had provided no regular system of education for girls. In spite of a not very successful attempt of Duruy in 1867 to organize lectures for them with the help of professors from the boys' lycées and colleges, it may be said that the girls had really no choice but between education at home or in private schools, chiefly in convents. Within six years (1881-1887) 35 lycées and colleges for girls were founded in as many towns, and the number has since rapidly increased. In these the lessons are now given everywhere by lady teachers qualified after studying in the universities or in the special training college of Sèvres. There was at first a strong prejudice against these establishments among the families that were accustomed to another sort of feminine education, but it is gradually dying out, though it cannot be denied that, even at the present time, the great majority of girls are still educated in private and congregational schools.

Superior Education.—Of the 25 universities that existed in France before the Revolution, 13 were suppressed in 1793 and have not been reopened since; four new ones have been created, bringing the total to 16. Here they are in the order of their foundation: Montpellier (1125), Paris (1150), Toulouse (1230), Grenoble (1339), Aix-Marseilles (1409), Caen (1431), Poitiers (1431), Bordeaux (1441), Besançon (1485), Nancy (1572), Dijon (1722), Rennes (1735), Lyon (1808), Lille (1808), Clermont (1808), and Algers (1849).

A university consists of four Faculties: Letters, Sciences, Medicine, and Law. At the head of each Faculty is a dean elected by the professors and placed immediately under the rector of the university, who, it must be remembered, is the chief of the academic province of which the university is the centre. The lectures in each Faculty are given by «professors» who must be doctors, and «maîtres de conferences» (tutors or lecturers) who are agrégés (fellows). These lectures are open to all undergraduates that have duly matriculated, *i. e.* who, being in possession of the necessary diploma of «bachelier,» have entered their name on the Faculty's register, and paid the matriculation fee of 100 francs a year. This, with 30 francs for the use of libraries and laboratories, is all that the undergraduates have to disburse. Such small sums of course cannot be regarded as a retribution for the lessons received, but as a kind of duty exacted to ensure the legal status of the student. Officially, superior education, like primary education, is gratuitous.

Two degrees may be taken at a university: The first is the «licence» (the old *licentia docendi*) for letters, sciences and law, and the second the degree of doctor which is the reward of at least one scientific work (thesis) presented and publicly discussed by the candidate that must already be «licencié.» The old medical licence having been suppressed long ago, doctors of medicine make an exception to the otherwise general rule that to be a doctor one must first be a licencié, but the test of their attainments and ability is previously made in progressive examinations during the course of their studies which extend over five years at least.

To the universities proper that have been enumerated above, should be added the Superior medical schools of Amiens, Angers, Limoges, Nantes, Rheims, Rouen and Tours. As regards the University of Paris, one would have a very incomplete idea of it, if one limited it to the four Faculties that have the Sorbonne for their centre. It includes a large number of establishments of which the College de France, Ecole des Chartres, Museum, Ecole des Hautes Etudes, Ecole des Langues Orientales are only the principal. More or less directly connected with it, though not all placed within the authority of the Minister of Public Instruction, are also the Ecole du Louvre, Ecole des Beaux-arts, Ecole des Arts Décoratifs, Conservatoire, Ecole Superieure des Mines, Ecole des Hautes Etudes Commerciales, Ecole des Sciences Politiques. Even if one leaves these schools aside, and only takes into account the former, that are the natural complement of the four Faculties, the University of Paris appears as something unique in the world. To give an idea of its importance it suffices to say that of the 21,033,778 francs annually spent on superior education, 9,952,191 francs, *i. e.*, almost one half, are absorbed by the University of Paris alone, and that the number of its undergraduates exceeds 12,000.

Whether this affluence in Paris is a good thing, may be and has often been discussed; it is a fact that it takes from the provincial universities their best teachers and a large proportion of their students, but at the same time it is undeniable that this very density of the scholastic population of Paris is a strong stimulus to intense intellectual labor; there is no place in the world so replete with illustrious names or so productive of remarkable achievements, both literary and scientific.

III. *Private Education.*—The monopoly of teaching which Napoleon had given to the Imperial University, and which the Royal University retained after it, was abolished, practically in 1830, and officially in 1850 by the Falloux Bill. This bill, though recently modified in many of its clauses, has not been recalled as regards the liberty of teaching.

Since private industry and charity were allowed to compete with the public treasury, the competition has been a sharp one; the development of the national schools was everywhere attended by a parallel increase of the private ones. It is worth remarking, however, that this régime of liberty chiefly served the interests of the Catholics who, opposite the State University of France, built up, as it were, a university of their own, including establishments of the three degrees, primary, secondary and superior. Indeed, so preponderant is their influence in the so-called «enseignement libre», that a private school is generally understood to mean a Catholic school.

The private establishments being as exact a copy as possible of those which belong to the State, there is no necessity to insist much on the subject. Yet a comparison of their respective importance cannot be dispensed with; it will moreover have the advantage of showing that an efficient preponderance is ensured to the National University. As the statistics were made before the recent expulsion of most religious orders, which could not but affect some of the private schools, this comparison is only an approximation; but on the other hand, in most cases the place of departed ecclesiastics having been taken up by Catholic lay teachers, the figures given below may be considered as sufficiently exact. With regard to primary education, the State establishments are far ahead of the others, with 67,340 schools, 100,913 teachers, and 3,671,727 pupils, against 14,331 private schools kept by 41,747 private teachers and receiving 925,301 pupils. It was chiefly in secondard education that the competition of private industry was successful, for the French middle and well-to-do classes are to a large extent favorable to Catholicism. The number of boys is virtually the same in private colleges as in the State lycées and colleges: 86,347 for the former, against 86,371 for the latter. The competition is more successful still as regards the education of girls: the State colleges, it has been said before, attract but a comparatively small number of them. Here the Catholics have an undeniable advantage, but they are far behind with their universities. They gave the utmost of their effort in 1875 when they founded three Catholic universities in Angers, Lille and Lyons, and a Catholic Institute in Paris. For these they are wholly dependent upon charitable foundations (superior education being gratuitous, and the matriculation fees being received by the State); so, far from being able to increase them, they experience great difficulty in maintaining what they have created. On the whole, therefore, the superiority of the State establishments is obvious and assuredly sufficient to reward the pecuniary sacrifices of the nation. But in France the religious quarrel has reached almost a crisis; and the fact that the education of the higher classes is almost equally divided between the government teachers and the Catholic masters, seems to many an alarming state of things. What has been called the «crise universitaire» has been and is still daily discussed passionately; and although republicans should shrink from such drastic and unliberal measures, some restriction of the right of teaching may be anticipated—possibly in the near future.

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11. **France—French Language and Literature.** *Origin.*—French is derived from Latin. The groundwork of the language was formed

not with classical Latin but with colloquial Latin spoken by soldiers and colonists. With the progress of culture, Latin had developed a double growth, a vulgar tongue (*sermo rusticus plebeius,* castrense verbum) and a nobler speech (*sermo nobilis*). Not only were the grammatical forms simplified by the former in point of cases and inversions, but each one had its own vocabulary, *e. g.*:

ENGLISH	PATRICIAN SPEECH	VULGAR LANGUAGE	FRENCH
battle	pugna	batualia	bataille
to help	juvare	adjutare	aider
week	hebdomas	septimana	semaine
to eat	edere	manducare	manger
horse	equus	caballus	chaval

As early as the 1st century A.D., vernacular Latin had superseded Celtic throughout Gaul, Brittany excepted. Strabo no longer looks upon the Gauls as Barbarians. Celtic, not being written, was completely swept out of use. It left but very few terms in the Gallo-Romans' speech, hence in French, *e. g.* alauda (alouette), cervisia (cervoise).

Latin was hardly master of the land, when the Germanic tribes pressed upon the border. Rome held them back for a century or so by a system of military colonies (lètes) filled up with Franks and Burgunds. As a consequence Germanic words referring to war began to take root in Roman Gaul. In the 2d century, literary Latin was flourishing, but the middle class declined, Latin culture with it, and in the 5th century patrician Latin was ruined and the vernacular idiom in general use. The work in progress was not stopped by the invading Franks. They forsook their own tongue and adopted that of the conquered (1) because they numbered hardly 13,000 against some 6 millions; (2) because the Germanic tribes had no uniform language; (3) their conversion to Christianity worked in the same direction. Yet the Frankish idiom left more words than Celtic in the vernacular. Outside war terms, the Franks brought feudal institutions for which there were no words in the language of imperial Rome, *e. g.*:

FRANKISH	FRENCH
alod	allen
bann	ban
skepeno	échevin

About 900 words were thus imported. Meanwhile, the syntax was also changing, but not under Germanic influence. The great change consisted in the prevailing use of the Latin prepositions *ad* and *de* in lieu of cases to denote tendency or possession. *Liber de Julio* led to *le livre de Jules; dono librum ad Julium* led to *je donne le livre à Jules*. This analytic process was also operative in the evolution of auxiliaries in the conjugation. In the 7th century, the «Romanic rustic tongue» was built up quite apart from Latin as well as from Teutonic: it had all the constitutive elements of French.

The first text extant of this infant French is known as the *Reichenau Glosses,* of 768, the year when Charlemagne was king. It is a glossary for a Latin Bible, an evident proof that Latin was no more understood even of such as could decipher MSS., *e. g.*:

LATIN	EARLY FRENCH
galea (helmet)	helmo (heaume)
tugurium (cottage)	cabanno (cabane)
caementarii (masons)	macioni (macons)

So, the subjects of Charlemagne spoke Romanic or Early French. The Church did much to spread it: Council of Rheims, 813, Council of Strasbourg, 842. At the latter place, and in the same year, French was used as medium between Louis the Germanic and Charles the Bald. The *Strasbourg Oaths* are the oldest French sentences on record. Poetry gave it its final consecration under the form of *cantilènes,* short lyrico-epic poems to the memory of saints, *St. Eulalie,* 9th century, *St. Léger,* 10th century.

Early French (10th century-14th century).—Let us now look more closely into the phonetic laws after which the new vocabulary was formed. The main rule is the persistency of the accented syllable, in words of popular origin; 2°, the short vowel just before the accented syllable, is left out: sanitatem=santé; 3° the middle consonant, *i. e.* placed between two vowels, falls off: augustus=août. These rules were disregarded by the scholars, who coined words, when they failed to feel the old Latin stress. Then the same Latin word sometimes gave two French words, one of popular making, the other of scholarly formation, *e. g. advocatum*=one avoué, two avocat; *porticum*=one porche, two portique; *fragilem*=one frêle, two fragile; *organum*=one orgne, two organe. These forms, called *doublets,* are about 800 in French.

The chief character of Early French or *langue d' oil* (as distinguished from the *langue d'oc* spoken south of the Central Plateau) is that it is a semi-synthetic tongue with two cases for subject and object, thus half way between Latin purely synthetic with six cases and Modern French purely analytic with no cases. The analytic process was at once more thorough with the conjugation: the auxiliary *avoir* with the past participle brought about all the compound tenses; the auxiliary *être* gave a new kind of passive verb. The future and conditional were original formations, devised by adding the present or the past of *avoir* to the infinitive: *aimerai*=aimer ai; *aimerais*=aimer ais, contraction of *avais*.

Very soon French gained great credit in Europe owing to the political ascendency of the Kings and to the qualities of the language, further evolved than any, Italian alone excepted. Cp. Dante (*de vulgari eloquio* I, 10); Martino da Canale, Brunetto Latini, etc.

The poetry of Early French was chiefly narrative. The poets were called *trouvères,* inventors (makers). Their tales centered round Charlemagne, Arthur, Alexander; hence three cycles of *chansons de gestes*. The masterpiece of the first was the *Song of Roland,* sung by the Normans on the field of Hastings. It contains 291 verses of lines with *assonance, i. e.* vowel-rhyme only. It is the epic of the feudal aristocracy, painted with vigor, life and touches of pathos. In French, the Arthurian cycle produced the poems of Chrestien de Troyes, full of sweet gracefulness. In the classical cycle we find the 'Romance of Troy' and the 'Romance of

Alexander' written in the 12-syllable line which hence took its name «alexandrine.»

With the play of Adam (12th century) the French drama begins its long career. As was the case in Greece, play-acting was evolved from the ceremonies of religious worship. In the 13th century, the spirit of chivalry is waning and the spirit of satire gives birth to a new kind of poetry, the *fabliau,* a comic tale intended for recitation. The most famous is the 'Romance of the Rose', translated by Chaucer. They combine amorous devices, wit and humor.

On the stage, many plays are produced, some of a religious character (*miracles*), others of a distinctly lay and comic vein (*soties, moralities, farces*). Prose for the first time is brought to eminence by chroniclers of great personal worth, Villehardouin (1213) 'Conquête de Constantinople' and Joinville (1318) 'Memoirs.' With their either stern or winning but ever clear and effective diction, the early period comes to a close.

Modern French.—(1). *14th Century.—Renaissance.* (a) The evolution of languages follows the evolution of societies. After Saint Louis' reign, the highest development of the Christian-feudal civilization, a long struggle begins between the mediæval and the modern spirits. The coming victory of the latter is evinced by the triumph of the analytic process: French casts off its two cases. Then followed a period of grammatical confusion, still enhanced by the wholesale invasion of words brought in by translators and all of scholarly formation. All the 15th century was necessary to build up Modern French, just in time to house the ideas and ideals of the Renaissance. (b) The unsettled state of the language told on the value of the writings. Poetry was much enfeebled. Christine de Pisan wrote loose easy verse; the two poets of the period are Charles d'Orleans (+1465) the last of the *trouvères,* whose perspicuous and refined style is still charming; and Villon (+1470?) the first of the moderns, whose frank confessions are both realistic and romantic. Prose won the day with Froissart (+1410), the greatest chronicler of the Middle Ages, the painter of the most varied, picturesque and living fresco, and Commines (+1511) who worked on entirely new lines in his business-like *Memoirs,* where he goes so far as to anticipate Montesquieu. On the stage, the *Miracles* sometimes struck up an eloquent note in a mass of prosaic lines; the *Mysteries* lived on to the eve of the Renaissance and comedy, a completely original start, was brought to life in the farce of *Pathelin* (circa 1465).

(2). *Renaissance.*— (a) The French language went on ripening. Calvin's 'Institution' (1535) testified to its richness, vigor and force. Owing to political influences (Italian wars and marriages) it was spoiled by Italian words and idioms against which Malherbe (+1630) fought with so much success that he overran himself and made the language not only purer but poorer. He reformed verse too, banishing hiatus, run-on lines, and bringing cæsura to chime in with the sense.

(b) Marot (+1544) is the poet of transition. He left the glory to found French classical poetry to Ronsard (+1585) and his friends, the Pleiad, the most shining stars of which, next to him, were DuBellay and Racan. DuBellay wrote the manifesto of the new school in his 'Defence and Illustration of the French Language.' Setting apart playwriting as the province of Jodelle, Ronsard restored all the forms of ancient poetry, ode, elegy, eclogue, hymn, epistle, satire, and sonnet, stanza both after the Italians. He was a true lyrical genius. His style is somewhat strained with erudition. His group did much to make the poetical diction more pure and supple. They lacked neither enthusiasm nor art-feeling, but perhaps some depth of inspiration. Outside their circle, Agrippa d'Aubigné reached the highest degree of vehement indignation, and woe in his 'Tragiques.' The dramatic vein, then so rich in England, was poor in France, in spite of the learned efforts of Jodelle and Garnier in tragedy and Lariney in comedy. A great creator in imaginative prose was 'Rabelais' (+1553) whose *Gargantua* and *Pantagruel* are household names the world over, whose style was so rich and so precise in his studied copiousness. Amyot translated 'Plutarch,' and Montaigne, with easy-going scepticism, wrote the history of his own feelings and thoughts in his 'Essais' (1580): both of them were read by Shakespeare.

Classical Age (1601-1715.)—(a) As to language, a Spanish mania followed the Italian craze. The new words thus naturalized were dearly paid for by bathos and bombast. Malherbe's purifying work was carried on by a worldly set (Hotel de Rambouillet), by the French Academy (Richelieu, 1635) and by grammarians: Vaugelas, d'Olivet. Henceforth, the story of the language would be the story of the influence exerted by great writers. (b) The first part extends to the early plays of Corneille. In satire, Regnier (+1613) was a follower not of Malherbe but of Ronsard and Desportes, with exceptional humor, popular wit and sense. Hardy was a Shakespeare without genius, powerless to stop the growth of the classical drama. De Balzac gave models of oratory prose: he was the Malherbe of written eloquence. He was followed by the church orators Bourdaloue, Fléchier, even by the greatest of them Bossuet (+1706). Other eminent prose writers were in philosophy Descartes (+1680) and LaBruyère (*Caractères,* 1688). Three ladies rose to literary fame, Mme. de La Fayette, with the first psychological novel (1678), Mme. de Sévigné, and Mme. de Maintenon with their 'Letters.'

Poetry, and especially Tragedy, reached classical perfection with Corneille (1606-84) who introduced upon the stage the struggle between passions, between duty and love ('Cid,' 1636), love and patriotism (*Horace*), human love and divine love (*Polyeucte*). A heroic strain pervades matter and verse. To love Corneille is to love greatness: his work is the dramatic song of the human will. Rotrou (+1650) serves for link between Corneille and Racine. Nothing goes farther away from the Shakespearian drama than Racine's tragedy which, in his own words, "is a simple action with no load of matter, never straying from what is natural to run to extraordinary extremes, by degrees pacing to its end, sions of the characters. (*Andromaque* 1667, *Britannicus, Phèdre* 1677.)

(3). 18*th Century.*—(a) People then esteemed that French was fixed forever. But only dead languages change no more. Yet, new words were few in this period: changes in the spelling were advocated (*ai* for *oi*, by Voltaire). The tendency was to an undue strain after polished noble style which often landed authors on cold and somewhat barren regions. (b) In the field of literature, changes were many. The first period, extending to 1750, is one of reaction tempered by respect; in the second, the fierce struggle bursts out and a sudden revival in spirit, if not yet in manner. Comedy ran on its merry career with Regnard (*Joueur* 1696), Dancourt and Marivaux (+1763) who created a comedy and a style of his own,—pleasant skirmishes of feelings not very deep, marvellously adapted to the stage and expressed in a wilful, skimming, subtle, playful sort of diction that has kept his name «marivaudage.» Tragedy sank deep with Crébillon and could do little more than floating with Voltaire (*Zaïre* 1732, *Mérope* 1743). The 18th century is a great age for prose. Fontenelle (+1757) taught the public respect for science and gave scientists a taste for good writing. As an interpreter of science to the many, he was a forerunner of the *Encyclopédie*. Voltaire took the hint (Newton). Then, in his so-called *Romans*, he scattered all over human thought and feeling the satirical sparks of his wit. His 'Letters on the English' are filled with the sceptical spirit of Bolingbroke. In history, he was not a discoverer but a sagacious writer, (Siècle de Louis XIV.'). Later on, he returned to verse and excelled in *satires* and *epistles*. His vast *correspondence* is the marvel of a versatile mind. His influence was paramount against Christianity and, in spite of himself, against monarchy. Two names only shone as bright as his: Montesquieu (+1755) and Rousseau (1712-78). Montesquieu created the philosophy of history with 'l'Esprit des Lois' (1748). Rousseau had still more influence, and one of a distinctly sentimental nature. His paradoxes are responsible for much in the course taken by the Revolution. His 'Discourse on the Origin of Unequality' 1755) contrasts the so-called *état de nature* with the evils of civilization. In 'la Nouvelle Héloïse,' he enriched French literature with the style of natural descriptions. The 'Contrat Social' is a theory of democracy and 'Emile' a treatise on education. Most revolutionists were Rousseau's disciples. Diderot (—1786) and d'Alembert (—1783) were the two editors of the *Encyclopédie*, a general review of human knowledge conceived in the reforming spirit of the time.

The Revolutionary period, opened by the mirthful satire of Beaumarchais ('Mariage de Figaro') was not favorable to literature; orators caught the public ear (Mirabeau) and the only great poet was revealed only after his death, André Chénier (—1794 'Idylles, Iambes') who poured his rich new wine in old amphoras.

4. 19*th Century.*—(a) The Revolution, romanticism, foreign imitations, scientific progress, inventions and journalism were so many breaking up antiquated restraints in verse. (b) The death of Chateaubriand and a new revolution (1848) fitly divide the century into two parts. In the former, Chateaubriand is master and king: the 'Génie du Christianisme' quickened a much needed reaction and *René* was the first to catch the melancholy contagion. He displayed his descriptive powers in 'Martyrs.' He was the greatest poet of French prose. Joseph de Maistre supported the same cause with philosophic vigor and stern eloquence. Another reviving spirit was that of Mme. de Staël who, by interpreting *Germany* to France, gave birth to modern criticism (1810). The soul of poetry returned to French literature with Lamartine 'Méditations,' 1820), Vigny ('Poems,' 1822,) Musset and Hugo, the sonorous echo of this universe, the greatest lyric poet perhaps of all literature: 'Odes,' 'Ballads,' 'Leaves of Autumn,' 'Contemplations,' 'The Legend of Centuries.' In opposition with the lyrical self-confessions of romanticism, Gautier surrendered himself solely to the picturesque object. On the stage, Hugo comes out again first ('Hernani,' 'Ruy Blas'), but being over lyrical, the romantic drama was short-lived. Two other literary forms took an unprecedented extension: the novel and history. In its brimful stream the novel was fed with all the living waters of the literary summits: there, George Sand was queen and Balzac king supreme, in fact, the French prose Shakespeare. History was born anew in the works of Thierry and by turns thoughtful with Quinet, stern with Mignet, lyrical with Michelet, business-like with Thiers, philosophical with Tocqueville, achieved wonderful work. By degrees romanticism subsided into the tamer Parnassus school, and Flaubert being the link, naturalism rose from the very excesses of pure fantasy: Zola, Maupassant.

On the first steps of the 20th century, the position of the French language is not quite that of undisputed eminence in the world, as it was at the end of the 18th century. But recent departures in poetry and in prose tend to show that the French language is still evolving in ever-renewed fruitfulness.

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12. **France—French Art.** *The Sources of the Renaissance.*—Art in France, as in all European countries, emanated—in its two essential forms, sculpture and painting—from architecture. Frescoes and statues, exclusively of sacred legends, served to decorate the churches and palaces. It was but gradually—during the last five centuries only—that French painting espe-

cially, has been divided into historical painting, landscape painting, genre, and still life, and that sculpture has, according to Spencer (who explains the evolution of the history of art by the law of differentiation), become «heterogeneous» through the variety of subjects, both realistic and ideal, of which it treats.

Mosaics play a prominent rôle in the decoration of basilicas, and later of Christian churches; Byzantine influence extended to iconography and to the miniatures in missals. The development of art, from the Roman churches of the 11th century to the Gothic cathedrals of the 13th century, attained unprecedented perfection. The sculpture of the cathedrals of Chartres, Amiens, Rheims, and Paris—by their simple and exquisitely naturalistic forms—realized the highest ideals. The decoration of the façades and the portals, like a living encyclopedia, fully reflect the faith and the aspirations of an age of earnest religious belief. All the industrial arts, ornamental sculpture, cabinet-work, church windows, missals, and goldsmiths' work, were in unison in the middle ages in France. The director of the work was, at the same time, sculptor and painter as well as architect. In the 13th century French decorators turned aside from Byzantine rigidity and archaism (Sainte Chapelle de Paris, and Donjon of Coucy). Then the workmen were employed in decorating the dwellings of the nobles. Charles V. and the Duc de Berry exercised a great influence over the French school. The court of the Duc de Bourgogne vied with that of France in the magnificence of its art; calling itself the great Bourguignonne school. The Chartreuse de Champniol, near Dijon, is the most significant example. On the other hand the "ravaux," ordered by the popes during their sojourn in Avignon, were not without their influence on French decorators, bringing them in contact with Italian artists.

Jean Fouquet, a portrait painter, limner, and fresco painter, connected with the court of Louis XI., made this progress still more apparent. Jacques de Litemont decorated the chapel of the House of Jacques Coeur in Bourges. The sojourn of the court on the banks of the Loire brought a great many artists to Touraine and those from Italy brought with them the new lessons they had learned from antique art.

Jean Bourdichon of Tours and Jean Perréal, brought back by Charles VIII. when he returned from his expedition to Naples, rivaled the ultramontane artists.

With Francis I. Italian decoration and style reached their culmination: at Fontainebleau, the king placed a great many painters and artists skilled in stucco under the direction of Primatice, which resulted in the beautiful gallery of Francis I.—one of the most perfect «ensembles» that the Renaissance has produced. Under Henri II. and Catherine de Medici, the school of Fontainebleau followed their lead. While French architects and builders attached to the kings of France erected the Chateaux of Gallon, Blois, Meillan, Chenonceaux, Fontainebleau, Ecouen, Anet, Chambord, and lastly the Louvre and the Tuileries, which have made the names of Pierre Lescot, Philbert Delorme, and Jean Goujon illustrious, their wonderful tombs and fountains are to be seen everywhere. Conspicuous in French sculpture are the names of Michel Colombe, and of Ligier Richier, and later, in the reign of Francis I., that of Jean Goujon (who was the first, in France, to do bas-relief), and of Germain Pilon.

The 17th Century.—During the great expansion of the Renaissance, wherever the influence of the Clouets (portrait painters of psychical insight) predominated, French art maintained the greatest independence, notwithstanding the official pressure brought to bear in favor of Italian art. At the end of the 17th century, art had but one head—the king: and he expressed but one idea: absolute power. French art became monarchical, reflecting the monotonous majesty of the sovereign, and his servile flatterers, who could and did say of the state: «It is I.» It was now necessary to have a dwelling proportionate to these excessive pretentions. Architecture, painting, and sculpture basked in the sunshine of royalty. It is not quite natural for people to submit to such rigid rules. Even the gardens became monarchical in style, everything was imperial, theatrically pompous; then followed the portraits of a Rigaud, a Nateuil, and even the pompous divinities in the garden of Versailles. The methodical minister, Colbert, formed a comprehensive plan for the protection of art. François Mansard, who built the palace of Mazarin, was imitated by Claude Perrault who constructed the splendid colonnade of the Louvre; and above all by Hardoin Mansard, his nephew, who designed the palace of Versailles, and the chapel and the dome of «Les Invalids.»

Sculpture, in its turn, was held in leading strings, Giradon, Coysevox, Nicolas Coustou, and Lemoyne designed great works along these lines. It was only the genial Pierre Puget whose ardent and passionate temperament would not yield to discipline. Thus he lost the favor of the public, who leaned towards the style of LeBrun in his great decorative enterprises. It was these artists who peopled with marble Versailles, Trianon, Marly, and Saint-Cloud.

In painting there was the same love of display, except in the works of the Lenian brothers, who portrayed the peasant. Simon Vouet, in the reign of Louis XII. ushered in LeBrun. Nicholas Poussin, whose style in historical landscapes is unsurpassed, lived in retirement in Rome, where he formed the style of Claude Lorrain—a wonderful analyzer of light,—aside from this movement in which even the austere Philippe de Champagne and the suave Le Sueur took but little part, LeBrun is the artistic spirit the 18th century in France. The position of Director of the Academy having been created for him, he grouped the artists as he wished. To him is due the stately gallery of Apollo in the Louvre, and his artists Lemoine, Monnoyer, Audron, Berain, Bourdon, Coypel, la Hire, Jouvenet, Van der Meulen, Regaud, and Largilliere painted portraits in a wonderful dashing style. Decorative art reached its apogée in the Gobelins manufactory of tapestries sup-

Exceptionally original talent was now seen in engraving—I refer to Jacques Callot.

The 18th Century.—A very natural reaction from the pompousness of the 17th century resulted in the piquant grace and the sensuality of the 18th. Caprice and subtile delicacy took the place of dull etiquette. «Prettiness» replaced «the Beautiful.» Art declined. The «Rocaille» and «Folies» styles succeeded. Nevertheless Gabriel, the architect, did not as yet abandon the deep-rooted traditions of his predecessors which he embodied in the façades of the Place de la Concorde. Soufflot, in the reign of Louis XVI., inspired by antiquity, built the Sorbonne in that style. But architectural style now aimed rather at «comfort.»

Sculpture was flourishing, after the style of Jean Baptiste Lemoyne. Two eminent sculptors, Pigalle and Houdon, partially escaped this craze, especially Houdon who made such a powerful bust of Voltaire. But the idol of the boudoirs was the voluptuous Clodion, whose very worldly creations seem to be caressed by the hand of Love himself.

Painting was in every way typical of the taste of French society in the 18th century. The pastorals of Franc Boucher; the fascinating «Fetes galantes» of Watteau; the charming nudes of Fragonard, sounding the praises of woman; the great Chardin, a man of the middle class, who escaped the false manner of his time, which engulfed Joseph Vernet, Hubert Robert, Oudry, Lancret, and Pater, painters of marines, of landscape, of the chase, and of gallantries; the sentimentality of Greuze, and the archness of Madame Vigee Le Brun, are offset by the keen penetration of the portrait painter Quintin Latour, a capricious pastel artist.

The 19th Century.—Another reaction took place. David revived the ancient Greco-Romano, and his horror of the license taken by Boncher led him to adopt a very severe style of art. His influence on his time was great. The David school, which had its origin in the painting of 'The Crowning of Napoleon I.,' includes the names of Drouais, Gidoret, Gros, Guerin, Gerard, Leopold Robert, and also Ingres.

Jean Dominique Ingres detached himself completely from the heroic style of his master. He was a forcible and skillful draughtsman, psychological, intense, a sensual «feministe,» and excelled the fascinating founder of French Classicism, but like him he confined himself to an æstheticism which sprang from his «esprit» which was inferior to his temperament.

The gentle and pure Prudhon was inspired, as well as David, by antiquity, but from a different point of view, that of vague dreaminess. Romanticism made its appearance with Gericault, the spirited and bold colorist of 'The Shipwreck of the Medusa.'

Romanticism, therefore, burst forth with a flourish of trumpets. Delacroix made his appearance,—lyrical, agitated, masterly, and ever restless, an excellent colorist, and a dramatic pessimist: he is Byronic, reminds one of Ber- ment of lyric art separated from schools and epochs. Almost at the beginning of the century Delacroix foretold the end. He was ignorant of the broken tones, which had been slightly discerned by Andrea del Sarto and Watteau,—the theory of complementaries as applied to pictures. This resulted in Delacroix being (1830) fully imbued with the Impressionist revolution which developed towards the year 1865. The feverish earnestness of his great spirit enabled him to surpass Ingres, produce a contrary current throughout the entire country,—a stiff breeze of independence. He repudiated codes and dogmas, and taught that the law of art is the scrupulous cultivation of individual expansion.

The struggle between Classicism and Romanticism was violent, and it soon gave place to another enemy—Realism. Romanticism spontaneously engendered from the soil an admirable school of Romantic landscape—Theodore Rousseau, who set his skies aflame as with precious stones and blood: Daubigny, self-contained and affected: Troyon, an animal painter as vigorous as a Dutchman: and Dias, florid, the votary of a muse too studiedly grounded. These landscape painters, followers of Ruysdael and of Claude Lorraine, possessed—besides the qualities of these masters—great keenness of perception, and the new theory of the vibration of color absorbing the outline without losing the form; and laying less stress on the drawing of the trees and hills than on the feeling for open air values.

And now comes the line of Romantic Realists instituted by Decamps, the orientalist; these will continue in Marilhat and the dainty Fromentin, one of the most limited in range of any of the artists of the Romantic school, and also Daumier, a superb worker in black and white, who, in addition to his celebrated lithographs, did innumerable small panels which are very expressive, thrillingly tragic, and of a grand and sombre spirit. The Romantic Realist Courbet—the grandson of the bitter Gericault — followed; then came Edouard Manet.

Camille Corot, however, the follower of Poussin, bathed his scenes from Virgil, in a diffuse, angelic, and superb light. The damp, chilly charm of the morning, the veiled mysteries of the evening, are the themes he chose. Corot is a unique master in French art. He has a very fascinating, delicate and consummate charm.

Another man standing alone is Jean François Millet, known as being the interpreter of the sad figures of peasants in the fields. He died in the settlement at Barbizon.

Courbet modified the trend of Romantic art; he took the lead in Realism, and was an artless, vehement and capable leader, forming his views directly from life, of excellent health, and in the first rank of historical painters. His style was degraded owing to the influence of the followers of Ingres, and he was fully imbued with the spirit of Flandrin—the conventional and insipid painter of the nude,—

and by Manet,—the Franz Hals of French soil. Round him are grouped Ribot and Bonvin.

At first under the influence of Velasquez, Goya, and Franz Hals, Manet tried his skill and found the bent of his genius. He eliminated all bitumen from the pallette, which left only the infinite combinations of the seven prismatic colors. He transformed Romantic Realism into a vision of modern life, and was noted for representing the manners and customs of the second Empire. He is not understood. The well known and conscientious critic, le Cafouent, paid him tribute 20 years after his death. His 'Olympia' has at last been placed in the Louvre. Manet broke off all connection with the Impressionists, but before taking this important and reactionary step he restored to their rank two illustrious men who, in the midst of Realism, mark the return towards mystic dreaminess: one of them is Gustave Moreau who carried out the heroic and legendary ideals of Eugene Delacroix in the dreamy magnificence of the Hindoo palaces, in the luxurious hieratisms of Hebraic royalty, and in the fabulous Hellas. He was a visionary idealist. The other one is Puvis de Chavannes, so long misunderstood, who is the greatest fresco painter of the 19th century, the author of Sainte Genevieve of the Pantheon, and of the celebrated mural decorations of the Sorbonne. He was not only a great painter, but a great poet. Impressionism now became noted This style however, was followed by neither Fantin-Latour —devoted to Wagner and Virgil, and an earnest and serene portrait painter,—nor by Carriere—happily inspired to paint his Maternities in mono-chrome. To explain better the spirit of these designs let me say that Carriere did not permit himself the use of color.

Impressionism is a special study of light. Claude Monet, a fellow-worker with Manet came into notice about 1867; he encouraged landscape painting founded on the vibratility of ambient light. The Impressionist school took its name from a picture by Monet, modestly entitled 'Impression,' which was ridiculed. The name of this work so ridiculed became a rallying point. Luminous effects predominate in the vibrating marines of Claude Monet. His pictures (a series of cliffs, of mill-stones, of poplars, and of cathedrals), copied at every hour of the day, all from the same angle, are different aspects of the same theme under the effects of the sun's rays. Monet employs the method of separating the tones; under his brush inanimate objects volatilize into iridescent and versicolored phantoms.

Near Claude Monet struggled Sisley, Renoir, and Camille Pissarro, who immediately fell under the spell of the «Petits Maitres,» forerunners of the Impressionists, Boudin and Lepécié.

If Monet affiliated with Claude Lorraine and Watteau, Renoir followed the 18th century and Boucher, but a Boucher of a different power. Exceedingly appreciative of female beauty he embodied it in creatures charmingly natural and glad to be alive, and he thus expanded only beautiful flowers of flesh under the rays of light, that they seemed to drink in at every pore. He was the great painter of the 'Moulin re la Galette,' the gem of the Caillebotte gallery, Luxembourg Museum. Berthe Morisot left a series of water-colors, exquisite, spirited and of refined taste, painted in a style between that of Manet and Renoir.

Alfred Sisley was like Claude Monet, with the exception that he laid much less stress on the experimental demonstration of a theory of art. His subjects, the environs of Paris, are noted for the quick and accurate perception and the light touch with which they are treated. Camille Pissarro sang, in a generous and frank spirit, of shepherds, market-gardens, and Norman villages.

To these names let us add that of Mr. Degas, one of the most keen, and least charitable observers of the life of to-day, a careful student of jockeys an unkind humorist, and a wonderful draughtsman; and also those of Messrs. Raffaelli, the late Monticelli, Lebourg and Guilla.

The teachings of Impressionism, even though denied by the corrupt followers of Ingres, Cabinel, and Bouguereau who was greatly Italianized, and by Meissonier and Gerome, «Petits Maitres» who lose themselves in minutiæ, are of advantage to the liberal minded. Mr. Besnard made some innovations in this direction in his great decorative compositions, and his brilliant portraits, painted in a most fascinating manner, show masterly handling. Henry Martin, a decorator and also a historical painter; Mr. Laurent, a portrait painter; and Mr. Le Sidaner, a landscape painter, all profited from this cleaning of the French palette. And the school of young artists claimed the name of «Neo-impressioniste.»

Before mentioning the names of the young generation it would be well to note those of the «Traditionalists» who defend—and sometimes with great ability—the academic traditions. They are the pure and Giorgionesque Henner, a painter of nymphs with ivory bodies; the classical Delaunay; the severe Jean Paul Laurens, portrayer of a civilation that has vanished; the melancholic Cazin with his fine fancy; the vigorous Roll; the delicate and nervous Henry Levy; in fact all the members of the Institute; Benjamin Constant; Bonnat, a pronouncedly pedantic painter, director of the «Ecole des Beaux Arts»; Mr. Detaille who represents military painting, cold and panoramic, never painting a graceful detail; Mr. Carolus Duran, an elegant virtuoso; Messrs. Flameng, Jacques Blanche, and Antonio de la Gandora, a skillful poser of female figures.

All these exhibit in the salons, either in the «Societe des Artistes Francais»—in which the most noted names are those of Messrs. Jules Adler and Hanicotte,—or in the «Societe Nationale» where Messrs. Cottet, Lucien Simon, Aman Jean, Rene Menard, and George Desvalliere compete with them.

This digression ended, we must—in order to describe those who fell heir to Impressionism, —single out two men who stand apart, whose talent though incomplete is not without great merit; Paul Ganquin the painter of Polynesian scenery and luxuriant vegetation in decorative rising masters of to-morrow who win distinction in the «Salon d'Autonne» and the «Independents»: Messrs. Vuillard, Signac Bennard, Maurice Denis, George D'Espagnat, Dufrenoy and Marquet. All enthusiastic young men of exuberant vigor, working very hard and taking pleasure in it, and who, notwithstanding their exaggerated colorists, do not despair of attaining renown in the true and liberal French school.

The limits of this brief study compel us to name, only, the illustrious draughtsmen, whimsical painters, or humorists, engravers, water-colorists, and lithographers, who recall Daumier, Constantin Guys, Gustave Doré, Avarni, and Toulouse-Lautrée, who bear witness to the originality and fertility of French imagination and humor; they are Bracquemond, Lepère, Chèret, Willette, Odilon, Redon, Forain, and Louis Legrand.

Sculpture.—From Rude to Rodin, including Carpeaux—the three geniuses who represent the entire French sculpture of the 19th century—much vigorous and delicate talent has been seen. Rude raised the standard of sculpture, which was very low at the beginning of this century. Rude was the unique artistic expression of the Napoleonic spirit, so unfavorable to every kind of art. His hauts-reliefs on the Arc de Triomphe de l'Etoile, are immortal.

Besides Rude, Barye,—a powerful animal sculptor,—the classicists David d'Angers, Etex, and Pradier are conspicuous under the second Empire, Carpeaux, the sculptor of the group called 'The Dance,' on the portico of the Opera House, and the bas-relief of 'Flora' in the Flora pavilion of the Louvre, and of a hundred charming «maquettes,» of masterly execution and refined taste, achieved grandeur through grace, style through fancy.

A brilliant constellation of sculptors was seen in the third Republic; Falguiere, delicately expressive; Dalou, severe and profound; Paul Dubois, subtile; Mercié and Trijalbert, who although declamatory in style are each gifted; and Fremiet, a pupil and nephew of François Rude. All these names and those of the «Rodinisants,» and the original genius Camille Claudel, Emile Bourdelle, Desbois, and Maillol, were overshadowed by the formidable genius of Auguste Rodin.

Rodin is the third term of this trilogy relating to Rude and Carpeaux. At first he was discussed, ridiculed, and disowned by the Institute because he purposely distorted his models so as to better display the intensity of ambient light: he conceived and executed his principal works, which are 'The Age of Brass,' 'The Bourgeois of Calais,' 'Saint Jean Baptiste,' 20 busts, and a hundred groups in marble and in bronze, illustrating the sad poems of love, of nervousness and of revery. He overturned all pre-conceived rules, going for his inspiration as far away as Assyria and Egypt, and the middle ages; his Victor Hugo and his Balzac are statues which caused in the artistic world, a sensation not as yet defined.

Architecture and Decorative Art.—The French the ancient régime, only apparently influenced the teachings of the arts. At first French architecture was under the yoke of the Greeks and the Romans. Deep study of the chief works of antiquity always inspires earnest artists, such as Percier and Fontaine; Vignon who built the Madeleine, and Brongniart, who built the Bourse.

Duban, Labrouste, and Vaudoyer revolutionized architecture. Viollet le Duc is charged with restoring Notre Dame, (1837). With Lassus who restored Sainte Chapelle, he struggled romantically against the «Academie des Beaux Arts.» Labrouste was the first to utilize iron, which may be seen in the 'Bibliotheque Sainte Genevieve'; Ballard was a bold innovator, who built the 'Halles Centrales.'

The wonderful inspiration of Charles Garnier, architect of the Opera house, is typical of the period of the second Empire. Still notwithstanding the modern spirit set forth in the teachings of Viollet le Duc, architecture is not yet emancipated; the ideas of Vignole and of Palladio, who imitated the antique, will disappear but slowly—with Messrs. Mogue de Baudot, and Vaudrenier. After all the rationalistic modernism of Messrs. Plumet, Chedanne, Gennoys, and Binet has erected monuments and dwellings commensurate to our needs, and to the ideas and customs of our time.

The revolution in applied art corresponds to that of architecture. The followers of Riesener, Gouthiers and Jacob will be the «furnishers,» such as Gallé of Nancy,—a cabinet-maker, and glass painter, who most always found his motives in floral naturalism; carvers, and goldsmiths with exquisite taste, such as Messrs. Dampt and Lalique, and lastly the makers of ceramics, Carriérs and Chaplet who rediscovered the art of the wonderful Japanese pottery.

In the foregoing is given a very short summary of the principles of French art.

The 19th century was one of such great fecundity that, under normal influences, art should take its part in all events, in the great struggles and in the great hopes that agitate humanity in the present day.

Let us say in conclusion, that art can now, less than ever, be said to be separated from life. French art is no longer, and does not wish to be, a thing apart from or aside from life. It is in itself the expression of life, not only in vague generalities, but in the most contingent phenomena.

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13. **France—French Music.** Such were the multiplicity and inaccuracy of the popular forms of primitive French music still in vogue in the Middle Ages, that in the beginning it is only possible to single out the peculiar mode

of expression that each temperament fashioned for itself. For instance, the *Trouveres,* who are considered the creators of lyric art, were hardly more than second-rate musicians who, being poets, sought in song a musical cadence with which to embellish their verses.

Religious music, which had long since been sustained by the voice of the organ, gradually found its way into the interior of churches and alone was quite representative of the mystic mentality of the Middle Ages. Even though it still adhered to liturgical chants which in form and style are subject to invariable musical modalities, it nevertheless began to be more flexible; slowly it expanded and assumed a fervor, an accent, a character hitherto unknown. The time was already near at hand when Josquin Desprez and, after him, Goudimel, were about to enrich with sound the wonderful gifts of life, order, easy grace and spirited joy that illumine the popular French soul.

However, it was outside of the Church that, as early as the 12th century, great interest was manifested in musical invention and research. Adam de la Halle, who, it seems, was the first to conceive melody in several parts, carefully represents that period in which music «d'ensemble,» if we may so express ourselves, already constituted one of the elements of popular amusement.

In the 14th century, during the reign of Charles VI., the instrumental resources of music began to increase greatly, and the minstrels, interpreters who at times were happily inspired, introduced the charming viol. Although very crude in the beginning, stringed instruments were destined to become more flexible, more expressive and more numerous, and those who played them gradually acquired a more delicate, more shaded touch. This evolution eventually gave rise to the first French chamber music, an art that was greatly advanced through the harpsichord, of which Couperin, Daquin, Dandrieu and the great Rameau were perfect masters.

Choral and religious music—which in the 14th and 15th centuries was at times so boldly realistic—was quite as fully and as cautiously developed. During the reign of Louis XII. it was revived by Josquin Desprez, who imparted to it inimitable earnestness and grace, and whether the subject were farcical or pious his motetts for several voices were simple masterpieces of juvenile spirit or emotional gravity. Of Goudimel, who was Palestrina's master, and of Clement Jeannequin, to whom we are indebted for that brilliant production, 'La Bataille de Marignan,' we can only say that in musical language of singular vividness, sincerity and splendor, they have portrayed both the fervent and the picturesque life that surrounded them.

The descriptive talent to which they owed their greatest success, the graceful and brilliant ease that was so preëminently theirs, were also characteristic of the musicians of the 17th and 18th centuries, who used them most freely, at the same time adapting them to the polite requirements of the time. Lulli, Daquin and Couperin at the harpsichord or on the stage showed the limitations of this intellectual spiritual art. Rameau, too, the learned, emotional composer of 'Dardanus' and 'Castor and Pollux,' dominates this brilliant epoch with all the noble pathos and tenderness of feeling that he was the first to bring into the life of music. Technically his work left its imprint upon one of the best periods of French musical history, the time when the beauty of instrumental composition and the varied power, then unknown, of the orchestra, asserted their harmonious influence.

After Rameau's death two other illustrious names lent glory to the close of the 18th century—those of Monsigny and Grétry. If the work of these two musicians, one of whom, Grétry, had a very adequate conception of dramatic truth and movement, does not sensibly elevate French tradition, at least it maintains therein a just solicitude for natural expression and sincerity. It was precisely this commendable solicitude that Méhul was a little later on to make his own, heightening it by the inspiration that he imbibed from the heroic spectacle of the great popular episodes of the Revolution.

French music of the 19th century retained the complex impressions of preceding epochs and, accordingly as the perverted taste of the multitude or the creative originality of great artists predominated, it reflected either the preference of the masses or the choice of the classes. In fact, all the different impulses that impart such brilliancy and tone to this century may be found mirrored in its music, being interpreted by various temperaments, some of which were among the finest identified with French art. The epopœia of the First Republic found in Méhul its most veracious and enthusiastic historian. An ardent admirer of Gluck, whose noble sincerity touched his heart, Méhul, well known to the men of his time, offered a miscellany of passion, valor and ingenuity that raised his work to the level of lyric composition. Undoubtedly the hymns that he composed during the troublous times of the Revolution savor a little of the grandiloquent, pompous air that it was the custom to impart to the smallest efforts in the line of creative thought. This is also the case with his opera 'Joseph,' which impels emotion because of the clearness, breadth and simplicity of its style. Besides, it was at this time when Italianism was so prevalent, that Méhul ably defended the traditions of Gluck, and for this reason alone should he claim our allegiance.

He and Gossec were the last representatives of this sober classicism, and Méhul struggled against the «maestri» with whom the versatile multitude, tired of heroism, began to be infatuated. But he seemed powerless against a fatal reaction. A brillant society eager to be restored to luxury and splendor and to be pleasantly entertained, required a rapid, showy, flattering sort of art which was introduced by fascinating Italian virtuosi, and Rossini and Spontini, assisted by Boïeldieu, Auber and Herold, transformed it and adapted it more closely to French style and taste, thus definitively naturalizing it. Of the Italians who invaded French theatres, Rossini was the most spiritual and most skillful. His cleverness, although extreme, was never enervating; he was both elegant and versatile and his quick, piquant music exerts a seductive influence to which one readily surrenders. If, where he aspires to genuine pathos, as in the opera 'Guillaume Tell,' Rossini's style is stilted and bombastic, in the score of 'Il Barbiere di Siviglia' he is fanciful, sprightly and eminently graceful, although a bit vulgar, hence his prolonged popularity.

But as much may not be said of Meyerbeer, who, like Rossini, won enthusiastic recognition on the French lyric stage. Although a native German, he inherited neither the heart nor the disinterested sincerity of the Latins nor the passionate, daring ardor of which the musical German is such a worthy exponent. Anxious to please, rather than to be original or to introduce novelties, he certainly knew how to cater to the taste of a public that wanted nothing but brilliant fiction. This rapid composer, to whom we owe 'Les Huguenots,' 'L'Africaine,' 'Le Prophète' and so many other productions, was also—the two attributes being singularly compatible—a technician of consummate skill; but these attributes seem rather to envelop than permeate his pompous, diversified music, somewhat grand at times and of which the great Schumann said: «It is all composition, outward show, hypocrisy!»

Rossini, an Italian, and Meyerbeer, a German, were, therefore, the admitted masters of the hour and the leaders of French musical fashion. Frenchmen unhesitatingly acknowledged the supremacy of these two foreigners over our dramatic music; and, at the time, the utter superficiality of contemporary life was more conducive to the discouragement than to the stimulation of artistic vocations. Of a care-free, brilliant temperament, the French adopted the course that seemed to beckon them to success, and as music of the touching, more learned type was not wanted, they produced comic opera.

What, then, should be retained of this period that was so poor and yet so well filled with musical history? Boïeldieu, Auber, Herold and Adam labored to endow our stage with animated, pleasing productions which breathed more or less of grace, sentiment and color. Some were successful in this line, notably Boïeldieu, whose 'Dame blanche,' M. Alfred Bruneau says has «much easy cleverness, chivalrous charm and spiritual sentimentality,» and Auber, who was the merriest, the smartest and most garrulous of all.

In order to conform to a mawkish conventionality French music had, as it were, to become subservient to the mediocrity of the public to which it catered, hence it was but timely that a powerful personality, revolting against the fashion and spirit of contemporary society, should transfigure it by imparting to it a love of strength and life. It was the hour of Romanticism. . . . What Victor Hugo was to do for literature, what Géricault and later Delacroix were to accomplish for painting, Hector Berlioz did for music. It is to him that, in this century, French inspiration owes the most famous and the most fruitful if not the finest of its tendencies.

Ardent, passionately fond of strife, Berlioz carried into it unparalleled enthusiasm and independence. The multitude treated him with indifference or hostility, but he stood his ground and each of his works continued to broaden the narrow limits within which, before his time, French music had been confined. Spontaneously he supplanted the affected elegance of his predecessors, their nervousness, their conventional agitation and the poverty of their musical resources, by a cordial sincerity, a pathetic sensibility, an ardent, noble inspiration, and a wealth of technical invention that place him first among our symphonists. The majestic 'Symphonie fantastique' and the terrifying 'Requiem' bespeak the excellence of his descriptive genius and lyric ability; the beautiful 'Enfance du Christ,' calm and peaceful as a fresco, shows us what a tender, delicate painter he can be, but it is in the 'Damnation de Faust,' and even more so in the 'Troyens,' that his full talent manifests itself. In these works he is no less compassionate than severe. He seemed to have inherited from Gluck a majestic and tragic simplicity in expressing the griefs or hopes of mankind. He was known as a trembling observer, an ardent, audacious delineator of the nature which he understood how to portray with a thousand daring orchestral strains then unknown, and we behold him posing as a depicter of the the human heart!

Underestimated during his lifetime, Berlioz nevertheless ruled the future of French music. If he did not inspire those who came after him, at least the example of his work impelled them to turn to nature and to life. Thus it was with Félicien David, composer of 'Le Désert,' that melancholy, expressive work, with Ambroise Thomas and Charles Gounod, the author of 'Faust' and of 'Mireille,' a pleasing musician with an easy, attractive style, and of whom Alfred Bruneau said that «he had created a langauge of tenderness that was deeply agitating.»

Finally came the admirable Bizet, another undervalued genius. The genuine candor, vivacity, daring, passion and sincerity that gave the French mind its individuality, fell to the lot of the composer of 'Carmen.' But it was only at his death that these were observed, and it was a tardy enthusiasm that was shown for the scores—masterpieces indeed—of 'Carmen,' wherein brilliancy and dramatic truth abound, and of 'L'Arlesienne,' which breathes of tenderness and life.

Two movements to which French music owes some of its most beautiful strains seem to have been simultaneously under way during the last 25 years of the century. The one, illustrated by names that are justly celebrated and popular, is characterized by the advancement of dramatic music; the other, perhaps more glorious, although less well known, is the revival in France of the symphony. The excellence of the former was attained through the efforts of Reyer, Massenet, Saint-Saëns, and later still through the labors of Bruneau, Gustave Charpentier, Leroux and Erlanger, whereas the latter movement has been immortalized by the names of César Franck, of Lalo and of Chabrier, while Vincent d'Indy, Paul Dukas, Guy Ropartz, and a few others have made its influence felt down to date.

In the line of dramatic music few countries have been able to show such a diversity of temperaments, and this is attested by the efflorescence of the works that have rendered the French lyric stage peerless. To be sure, these great operatic composers could not all boast of being innovators; some yielded complacently enough to the exigencies of a public that loves ease above all else, while others were powerless to withstand those influences by which their individuality was sometimes circumscribed.

It is in this sense that Reyer may be said to have been the first disciple of Richard Wagner in France. While it is true that the author of 'Sigurd,' a sincere, energetic musician, seems to have inherited from Wagner and Berlioz, as also from other sources, a love of pathetic sonority, dramatic passion and picturesque coloring, he is nevertheless an essentially French composer. If he has not Wagner's decided German labyrinthian scope and the heroic, masterful touch which, at times, cause the masterpieces of this genius to assume titanic proportions, he tempers his romantic tendencies by a thoroughly French sense of equilibrium and equipoise. Moreover, whatever Reyer may lack in the way of grandeur, he makes good in that of sense and clearness. The score of 'Salammbo,' emotional, strong and remarkably well carried out, is a most eloquent example of the order that he knows so well how to preserve in his noble, forceful lyricism.

If, like Wagner, Reyer desires to impress and to affect, Massenet seeks only to captivate, which he does by easy means. Diffuse, sensitive, elegant and refined, he appears as the restorer of gallant music, the best musical interpreter of delicacy and grace. 'Manon,' 'Esclarmonde,' 'Thaïs' and 'Ariane' manifest the skill with which he portrays the charm and the sensualism of love. His talent, however, is rather meagre. Although deeply appreciative of the eloquence of melody, he is hardly a symphonist. He sings and the orchestra dutifully sustains his song. With the exception of 'Marie-Madeleine,' which is perhaps his most beautiful work, his operas seem to be principally *suites,* although often exquisite ones, of «accompanied airs.»

On the other hand, Camille Saint-Saëns, who is a symphonist in the fullest sense of the word, likewise belongs to one and the other of the summary classifications heretofore indicated. A fascinating technician, conducting with rare power and marvelous presence of mind that many-voiced instrument, the orchestra, he has some of the finest qualities of the classic French mind: clearness, proportion, and will. He may be accused of lacking the spirit and adventurous freedom that is generally peculiar to men of genius and, reasonably enough, he may also be said to be more scientific than passionate or humane, but he is none the less a master.

In the 'Symphonie en Ut avec orgue,' and in some of his symphonic poems—expressive forms to which he was for a long time devoted—he gave forth his full power, and we admire the breadth and ease of his constructive and logical ability. In 'Henry VIII.' and 'Samson et Dalila' he is the ardent dramatic composer who, with consummate skill, places the expressive resources of the symphony at the service of theatrical action. Saint Saëns deserves to be called, above all, a great harmonist.

But the mention of these three great names that reflect such honor upon our dramatic music at once calls up others, as, of late years, there have been many able contributors to this very French form of lyric art. Alfred Bruneau, the austere, pathetic composer of 'Messidor,' 'L'Attaque du Moulin' and 'L'Ouragan'; Gustave Charpentier, to whom we are indebted for 'Louise' and those beautiful symphonic pages of the 'Vie du Poète' and the 'Impressions d'Italie,' impregnated them with a vivid, realistic romanticism; Bourgault-Ducoudray, Leroux, P. L. Hillemacher, Vidal and many others have devoted their splendid, expressive talents to the French lyric stage.

But, side by side with the advancement, however glorious, of lyric drama, came the magnificent revival of the symphony in France. Whilst the dramatic composers were contributing to the stage beautiful works which, presented in the effective setting of light and decoration, imparted to the plastic art a share of their expressiveness, there appeared on the scene César Franck, a man of simple, calm, emotional genius. Although in his day he also wrote the memorable dramatic poems 'Ruth,' 'Réoecca,' and 'Les Béatitudes,' that were pure and luminous as the Gospels, César Franck ennobles and simplifies music by restricting its horizon to the human heart. If he robs it of some of the picturesque descriptiveness that is one of its most attractive charms, it is to render it more sensitive, more humane, more chaste, it is the better to harmonize it with the misery, the hope, the blighted aspiration of a soul straining after the infinite. All the woes, all the joys that in turn can depress or animate the heart of a man, when he is a believer and a genius combined, are described by Pascal in a few lines which, to perpetuate them, César Franck put to music. He wrote a sonata, selections for organ and piano, a *quartette,* and a *quintette,* all exhaling passion, grief and faith, also a *Symphonie* and *Chorals* which are ardent, despairing, divine and may be said to be admirable dramas without words.

This power of symphonic expression that indicates César Franck's masterful talent, characterizes the work of two other composers, Edouard Lalo, and later, Chabrier, who, like Franck, were not duly recognized in their own time. Lalo's 'Symphonie espagnol' and 'Namouna,' and Chabrier's 'Gwendoline et Briseis' attest, under different temperaments, marvelous polyphonic richness. Saint-Saëns, Lalo and Chabrier were, it seems, the first in France to extend to the stage that new form of lyric expression wherein the orchestra becomes not the complement of song, but the very soul of the production.

César Franck's excellent artistic perception, the serenity of his life and the philosophical example of his work were no less ennobling in their influence than was his musical genius, and to all who have approached him this master bequeathed some of his earnestness, his depth, his discipline and his dignity. They have inherited his faith in pure music, and to-day they zealously propagate French symphonic tradition, on the stage as well as in concert. Vincent d'Indy, the most faithful of all to these teachings, has elicited applause for 'Fervaal' and 'Wallenstein,' strong, serious works in which musical power equals character. To Guy Ropartz we are indebted for Psalms and a fine *Symphonie*. Paul Dukas, the most personal, has pushed orchestral science and the power of independent musical expression to the extreme limit. In his 'Apprenti Sorcier,' which is dazzling, abstruse and heavy, intelligence eclipses sentiment.

However, it were rash to claim that the latest French music still bears the impress of César Franck's moral and technical influence. On the contrary, it displays a brilliant individuality and a contempt, lucky at times, for the traditions of the masters. Of all these musicians, the strongest, the only one who now deserves notice, is Claude Debussy, whose ardent, subtle, expressive music is that of a pagan and a sensualist quite destitute of humanity, as understood by Beethoven; it excites more sentiment, is more penetrating and more mysterious than any others and seems to assimilate the bewitching charms of nature that it so admirably reveals. 'L'Après-midi d'un Faune' and 'Pelléas et Mélisande' represent two important dates in the history of French music, and will probably prelude a renaissance of the descriptive music in which France has always excelled.

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PAUL-LOUIS GARNIER.

14. **France—The Drama.** Dramatic art, more than any other, is the reflex of its time and surroundings and the mission of the stage has ever been to reproduce, after duly magnifying them, those sentiments and ideas that have exerted the strongest influence over the mind of a people at each successive period of its history. This has been the case in France, as elsewhere, and to follow the evolutions of the French drama is to trace those of French society itself.

In the Middle Ages mysticism and religion were the foundation of popular life, hence the stage was eminently religious and its *mysteries* and *miracle plays* depicted Scriptural legends and the Passion of Jesus Christ. But, by degrees, profane life reasserted itself and engendered the Gallic spirit pervading the *allegorical satires* and *moralities*. The gay farce, 'L'Avocat Pathelin,' is a standard model of this style.

The Renaissance being the revival of antique types, dramatic themes were thenceforth taken from Greek tragedy and Latin comedy instead of the Bible, and this revolution begun by Jodelle and Robert Garnier in the 16th century, was carried into the 17th first by Rotrou and then by Corneille, being finally completed by Racine and Molière.

Corneille, sublime and bold, adapts himself but poorly to the rules set down by Aristotle, especially the three unities, but Racine, graceful and pleasing, conforms to them wonderfully well. Classicism is largely made up of effacement, if not servility, and is quite satisfied to clothe modern characters in antique raiment. It bids the contemporaries of the great king, the simple, rugged heroes of Corneille and the delicately complex heroines of Racine express themselves in the alexandrines of the classic stage and presents the psychology of great chieftains and their love in the guise of Greek and Roman fable.

Molière portrays perhaps even more vividly the period in which he lived. His comedy wears a mask, his most extravagant farces are but a shield for the heaviest tragedies. Domestic troubles, conflicting interests or opinions, the delineation of the most unbridled passions or the vilest conceits are presented to us in a medium whose effect it is to emphasize contrast: his work is in chiaroscuro and he exaggerates in relief the vices he holds up to view. An Alceste, a Harpagon, a Tartufe or an Argan can readily evoke, as the poet says:

> Cette mâle gaieté si triste et si profonde
> Que lorsqu'on vient d'en rire on en devrait pleurer
> (A. de MUSSET).

The 18th century, although rich in ideas, was poor in dramatic authors. The prescribed form of ancient art was disappearing and the new form had not yet been established. Voltaire's tragedies lacked strength and his comedies were purposeless. Classicism became extinct. Shakespeare, whose plays were only clumsily adapted by Ducis and Voltaire, was no better understood by the public than by his translators. Sedaine and Diderot were happier in their bourgeois comedies and showed a tendency, albeit an awkward one, toward society comedy by showing up the social and political conditions of the day, the enactment of the great bourgeois comedy.

Histrionic literature, as well as all other kinds, helped to pave the way for the French Revolution. In spite of the Censure, Beaumarchais attacked those men who «have taken the trouble to be born, but nothing more,» and, in the imperishable character of «Figaro,» immortalized a type of the populace which had fallen to be so little and had just begun to demand their old position.

During the revolutionary disturbance theatrical representations were an additional spur to revolt and Marie Joseph Chénier(a dramatist of the hour, endowed his heroes with the souls of sans-coulottes. Toward the end of the Republic and under the First Empire the drama in France was neglected as an art; it failed. The scene of tragedy was far greater and more real; it was shifted to the battlefields of Russia and Germany. Some very acceptable comedies were written by Andrieux, Collin and d'Harville, but there was not one original writer of great drama.

To the 19th century was reserved the glory of seeing a new form of dramatic art arise. The influence of foreign literature triumphed over the classical conventions; Shakespeare and Byron, Goethe and Schiller were set up against Corneille and Racine. Unheard-of liberties were taken; paraphrasing such as Delille's was scorned; a spade was called a spade, and that without any apology. Of course, such innovations raised a storm. Alfred de Vigny was hissed for his unvarnished translation of Othello, and Hugo was severely upbraided for daring to mention the «private-staircase» in the first lines of 'Hernani.'

Hence the necessary reaction of romanticism. Tragedy was replaced by drama, the old notion of the unities of time and place was cast aside, only the unity of action being retained, and heroes were borrowed from mediæval legends, the banks of the Rhine, the mysteries of Venice or the *romanceros* of Spain. A Ruy Blas or an Esmeralda, a Ruy-Gomez or a Lucretia Borgia was brought forward and in some of deMusset's fanciful creations could be traced the dim outlines of a Perdita or a Marianne. Nor was this all; contemporary life was mirrored in certain *Proverbes,* the 'Caprice, Il ne faut jurer de Rien' and in Alexander Dumas' 'Antony.'

From that time onward all varieties of drama were presented in uninterrupted succession, but the kind that appealed most strongly to the public was that which depicted contemporary society. Emile Augier pictures to perfection the spirit of the French *bourgeoisie* from 1830 to 1870, the business man being portrayed in the 'Effrontés' or in 'Maitre Guérin,' and the absurdly vain in the character of M. Poirier, while in 'Vautrin' and 'Mercadet' Balzac holds up to view the parasites of modern society.

Belonging to our own day and side by side with Sardou, who is admirable in stage technique but only mediocre as a psychologist, and Labiche, who is a skillful and finished writer of vaudeville, is Alexandre Dumas, Fils, who strikes out into *problem plays.* The problems that are stirring society to its very depths are exploited, discussed and analysed; the limelight is thrown upon the social status of the courtesan, the illegitimate child and the girl-mother, the worlding and the prostitute. The stage begins to act as though it meant gradually to get a hold on public opinion and to bring about reforms in legislation and morals.

This last mentioned style of dramatic art is daily gaining ground and is being strongly encouraged.

However, it is by no means the only kind patronized. Indeed, rarely has there been found in the history of French letters a larger or a worse variety. Seldom have brutality and bestiality been more highly indulged than in the wrestling matches of so-called athletes and boxers and even bull-fights where the æsthetic and dramatic character is supposed to predominate. Seldom, too, does one come upon literature inferior to that of the concert-cafés or of certain vaudevilles where all the author's genius has expended itself in combining suggestive deshabille with ribald joke and indecorous acting. Far too many look upon blackguardism as the *ne plus ultra* of dramatic art and some works, although abounding in humor, do not escape this ban. But these new theatrical fashions which, it must be admitted, are of foreign origin, are certainly not among the greatest boons conferred by the craze for copying foreign models.

However, in them, the undesirable element is merely superficial. Our theatrical men have never been more concerned with the questions of the hour nor more bent upon catering to the public taste. For every light operetta and amusing vaudeville performance we have ten heavy plays that cause one to think, that start ideas and are leading toward a radical reform. If divorce has given rise to a few humorous works it has been the theme of a great many serious ones wherein its advantages and its dangers have been exploited. We have Paul Herview showing in the 'Loi de l'Homme' and the 'Tenailles' woman's present state of subjection; Abel Hermant, Emile Fabre and the Brothers Margueritte, the ones inimical and the others favorable to the reform, showing us the family irremediably divided and human personality emancipated and reclaimed.

Or again we have François de Curel telling us in the 'Repas du Lion' of the bitterness of social strife and in the 'Nouvelle Idole' of the beauty and severity of science. Then, in his 'Avariés' and 'Avortment,' Brieux sets forth the great medico-social problem, daring to excuse, perhaps even to justify, the killing of the unborn infant whose coming into the world would bring naught save shame and misery to its mother and itself, while in the 'Robe rouge' the pharisaism of human justice is challenged. On all sides society is being summoned to the theatrical bar. Again the drama 'Biribi' depicts a revolt against the *penitenciers militaires* and the *compagnies de discipline;* the popular verdict passed upon the play determined the enactment of a reform of the law as to these *compagnies disciplinaires.*

A further character of this dramatic reform apart from the varied and conflicting opinions it has excited, is that foreigners have been given generous recognition. The French public has made the acquaintance of Ibsen, Tolstoi and Gehrardt Hauptmann, and under the impulse of younger men Anthony, King Lear and Julius Cæsar have been retranslated, fitted for the modern stage and have shown the French public a new and hitherto unknown Shakespeare. Marvellous stage-settings—an imitation of English excess—form the frame in which the characters of these masterpieces move and live, but for the historian their interest is that each drama is a revelation to the public of a new and foreign spirit.

Judging from the present, the future of the French stage may be easily conjectured. At no other time has it manifested such effervescence, such vitality, and the French world at large is subject to no more powerful influence than that exerted over it by the stage. It is the chief literary expression of our time and bids fair to remain so for long. See **Drama.**

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Gustave Rodrigues.

15. France—The Army and Navy. The President of the Republic controls all land and sea forces. He appoints officers of all grades and presides over the council of national defense, which includes the President of the Cabinet Council, the Minister of War and Minister of the Navy with their chiefs of staff, the Minister of Foreign Affairs and the Minister of Finance.

Military expenses are annually estimated in the budget (a statement of national income and expenditure), and in 1906 they amounted to 718,690,800 francs for the War and 325,000,000 for the Navy Department.

THE ARMY.

The Minister of War is the head of the administration of the Army. He is assisted by a general staff comprising four departments, devoted respectively to mobilization and general organization, the investigation of foreign armies and of the theatres of operation, army instruction and military operations and military transportation; and three sections, namely, the staff personnel, the historical, and the African section.

A geographical service insures the making and publishing of topographical maps dealing with France, Algeria and foreign countries.

The chief of staff is assisted by three immediate subordinates, one of whom conducts the geographical service.

The Central Administration of the Army includes the several branches of the War Department: infantry, cavalry, artillery, engineering, administrative services, the «powders and saltpeters,» medical service, colonial troops and the *contrôle* service, which verifies ministerial orders, decrees, etc., for the entire service.

In the study and investigation of plans and reforms the Minister is still further assisted by several technical boards, committees and sections. He is president of the *Conseil supérieur de la guerre* (a board that deliberates on questions of mobilization, concentration, supplies, etc.), the vice-president being the commandant selected from the principal *groupe d'armeés* (*i. e.* all the armies operating in one theatre of war and under the supreme command of one general), the other members of the board consisting of eight generals with high commands in mobilization, and also the chief of the general staff.

The Army comprises the active army and its reserve, the territorial army and its colonial troops.

Recruitment.—Every Frenchman owes his country personal military service which is equal for all. It is of 25 years' duration, two of which must be spent in the active army, 11 in the reserve of the active army (with two calls to four weeks' drilling); six in the territorial army (one call to 15 days), and six years in the reserve of the territorial army (one call to one day).

Annually, all young men who, before January 1 have completed their 20th year, are called to the army. Those who are or who have become unfit for armed service are classified in the *services auxiliaires* (any services performable by noncombatants) and are assigned to duty in the *dépôts du territoire,* in the departments, in the artillery, engineering and *intendance* establishments, etc.

Besides those summoned to enter the service the army counts a certain number of re-enlisted soldiers. Corporals, brigadiers and soldiers may re-enlist for one year, 18 months, two years, two and one-half years and three years. The noncommissioned officers of the metropolitan or home troops and all the soldiers of the colonial troops may re-enlist for four or five years, until they will have completed 15 years of service.

Territorial Organization.—With a view to the recruitment, mobilization, organization and assignment of troops, France is divided into 19 «military districts» numbered from 1 to 20 (Algeria-Tunis being the 19th). The headquarters are at (1) Lille; (2) Amiens; (3) Rouen; (4) Le Mans; (5) Orleans; (6) Châlons; (7) Besançon; (8) Bourges; (9) Tours; (10) Rennes; (11) Nantes; (12) Limoges; (13) Clermont-Ferrand; (14) Lyons; (15) Marseilles; (16) Montpelier; (17) Toulouse; (18) Bordeaux; (19) Algiers; (20) Nancy.

Paris and Lyons are the seat of special military government.

Each of these military districts (except the 19th) is subdivided into eight smaller districts (four in the 6th and 20th), each of which corresponds to an active regiment, a regiment of reserves and a territorial regiment of infantry.

Each regiment has a permanent place for mobilization, where the men required for active service meet and where the regiment's supplies and rolling stock are kept. It draws its reservists from a certain limited district which is its regional subdivision for reserves.

With a few exceptions France is divided into as many of these sub-districts as there are units of organization in each arm (145 for the active infantry, reserve and territorial regiments).

In every regional subdivision a recruiting bureau directs the men of the reserve and of the territorial army, assembles them for drill and summons them for mobilization.

The military districts answer as regional subdivisions of reserves for their *brigade d'artillerie* (two regiments to each corps except the 6th); the cavalry, engineering, light infantry and zouaves have special limited subdivisions.

Hierarchy and Recruitment of Officers.—No one can be admitted to a grade unless some form of military duty be connected with it; the duty is distinct from the grade. Colonels make appointments to the rank of corporal or brigadier and petty officer (sergeant, sergeant-major and adjutant in the infantry and engineering; sergeant, sergeant-major and adjutant in the other arms). Officers are promoted by order of the President of the Republic.

Officers are recruited (1) From the petty officers admitted after competitive examinations to the military schools of St. Maixent for the infantry, Saumur for cavalry, Versailles for artillery, engineering and the train, and who, after a year these schools, pass a successful graduation examination. (2) From the young men who, after a competitive examination, are admitted to the Polytechnic (artillery and engineering) and the School of St. Cyr (infantry and cavalry), and who, before entering these schools will have finished a year's service in the regiment.

The *officers of the reserve of the active army* are recruited from the young men admitted to certain schools—the *Ecoles forestières for* training administrators of the forests belonging to the state and to the communes; the *Ecole des manufactures* for training private engineers and manufacturers; the *Ecole des mines,* which cannot be entered save after a stage in the Polytechnic and the *Ecole des Ports et Chausseés* (in which former Polytechnic students are prepared for civil engineering) and after having completed a year's service in a regiment, and also from those of the contingent who, agreeing to take three supplementary periods of training during their stay in the reserve, submit to a competitive examination at the end of their first year of service. The students then follow a special six months' course in the regiment, and if at its completion they pass a successful examination, they finish their fourth year of service as officers of the reserve.

In time of peace, promotion in the active army is made in the following manner: all sub-lieutenants having held that office for two years become lieutenants. The promotion is made one-third by selection and two-thirds by seniority for the rank of captain, and half by selection and half by seniority for the rank of major of infantry or major of artillery. To the higher grades, those of lieutenant-colonel, colonel, major-general and lieutenant-general, promotion is by selection.

Make-up of the Active Army.—The active army comprises metropolitan or home and colonial troops. It has a total strength of about 28,000 officers and *assimilés* (*i. e.* noncombatants ranking as officers), 528,000 corporals and privates and 123,000 horses.

The *gendarmerie* is 24,000 strong; the infantry about 350,000; the cavalry 60,000; the artillery 72,000; the engineering 13,000; the train 6,800, and the administrative troops are 14,700.

At the head of the great units is the staff of the army, the first section of which includes 110 lieutenants-general and 22 majors-general, on the active list or unemployed.

The second section is formed of generals placed in the reserve.

The personnel of the staff service is made up of officers not on the rolls of a statutory organization (640 at most in time of peace) who have successfully followed the course at the War Academy and have received the staff college certificate.

Troops.—The *Infantry* is composed of 163 regiments, of which 145 are called ***subdivisional,*** that is to say, drawing their reservists from one of the regional subdivisions, having three battalions of four companies (some have a fourth battalion with a variable number of companies); the 18 other regiments with four battalions are called ***regional*** because, for recruiting purposes, they draw from a military district.

The subdivisional regiments have a supernumerary staff of field officers, eight captains and four lieutenants, who contribute to the officering of the corresponding regiment of the reserve, 30 battalions of light infantry with six companies (12 being Alpine battalions); four regiments of zouaves with five battalions of four companies, plus two depot companies; four regiments of Algerian rifles with six battalions; two foreign legions with six battalions; five battalions of light infantry for African service; four companies for the Sahara oases; four ***compagnies de discipline*** (punishment companies); one regiment of the Paris fire brigade with two battalions and six companies.

The regiments of metropolitan infantry are grouped into 80 brigades and 40 divisions, numbered from 1 to 42 (numbers 37 and 38 being missing).

The *Cavalry* comprises 89 regiments with five squadrons; 13 of Cuirassiers, 31 of Dragoons, 21 of light cavalry, 14 of Hussars, six of light cavalry for African service, and four of Algerian cavalry. The regiments stationed in France constitute 19 cavalry brigades attached to the army corps and eight independent cavalry divisions composed of two or three brigades.

The *Artillery* includes 18 battalions of artillery having a variable number of batteries, the total being 113, and 40 regiments of field artillery constituting 20 brigades (one to an army corps), with 442 mounted, 52 horse and 14 mountain batteries. The regiment numbered lowest in each brigade usually has 12 mounted batteries forming two half regiments (with two groups of three batteries each), each assigned to one of the two divisions of the army corps. The other regiment, which generally has three groups of three mounted batteries and one group of two horse batteries, constitutes the *corps artillery* of the army corps. Two horse batteries are attached to each of the eight independent cavalry divisions. The artillery includes, moreover, 10 companies of artificers or laboratory men and three companies of workmen.

The field batteries have four guns of 75m/m. Besides the troops, the special artillery staff, assisted by administrative artillery officers, is destined for the service of establishments (schools, arsenals, etc.).

The ***Engineering*** branch of the army comprises a special staff and seven regiments, six of engineer soldiers and one of railroad engineers: that is, 26 battalions, 20 of engineer soldiers, three of railroad engineers, one of æronauts, one of telegraph operators and one detailed to service in Algeria. The train includes 20 squadrons of three companies. The administrative troops consist of 21 sections of clerks for staff and recruiting duty, 25 sections of workmen, mechanics, etc., and clerks, enlisted as such, for military service, and 25 sections of hospital orderlies.

The *Gendarmerie* embraces 27 departmental legions and the ***gendarmerie*** of the city of Paris, which has three battalions of infantry and four squadrons of cavalry.

Besides the troops, must be included the personnel of the various services; of the ***contrôle*** service (whose duty it is to watch over and inspect the ***administration*** or the ***gestion***); the ***intendance,*** the medical service, the corps of administrative officers, the veterinarian corps, the "powders and saltpeters," military justice, the interpreters' corps, etc.

Reserve Troops.—These comprise 145 regiments of infantry and three battalions formed of the supernumerary officers of the 145 subdivisional regiments of the active army, and the officers, corporals and privates of the reserve; 30 battalions of reserve *chasseurs;* 40 regiments of reserve cavalry; 41 reserve squadrons; and, to each artillery brigade, 12 reserve batteries, namely, 216 battalions.

Colonial Troops.—These are connected with the War Office and destined, principally, for the Colonies. One part constitutes in France an organized army corps of three divisions. The Colonial troops are distributed as follows:

France: 12 regiments of infantry, three of artillery, five companies of workmen and one company of artificers or laboratory men.

Indo-China: Four regiments of infantry, four of Tonkinese rifles, two of Annam rifles, one battalion of Chinese rifles, one of Cambodian rifles, two regiments of artillery and two mixed companies of workmen and artificers.

Eastern Africa: One regiment of infantry, three of Malagasy rifles, one of Senegalese rifles, one of artillery and two companies of mixed workmen.

Western Africa: Three regiments of Senegalese rifles, one of Congo rifles, one battalion of Zinder rifles, one regiment of artillery and one company of drivers.

China and China Reserve: Two regiments of infantry, one of Tonkinese rifles.

The Territorial Army.—The troops of this army may, when mobilized, be detailed to garrison fortresses or fortified town posts, lines of halting-places, strategic points and coast defenses. They may also be formed into brigades, divisions of the army corps destined to remain in the field, and finally may be drafted as part of the active army.

The Infantry comprises 145 regiments of three battalions, that are connected with the active corps of their subdivision, seven battalions of light infantry with four companies (on the Alpine frontier) and 10 battalions of zouaves (Algeria).

The Cavalry varies in the number of squadrons which it allows to a military district, there being usually one squadron of Dragoons and one of light cavalry and three territorial squadrons of light artillery for African service.

The Artillery in an army corps consists of two territorial groups, each corresponding to one of the active regiments of field artillery, and 15 territorial groups of foot artillery distributed among 11 military districts (on the frontiers and seacoasts).

In each army corps there is also formed a battalion of engineers and a territorial train squadron.

Finally, to these troops must be added 31 battalions of custom-house inspectors, seven battalions, 19 companies and 14 sections of custom-house inspectors detailed to duty at fortresses, 45 active companies and 16 sections of *chasseurs forestiers* (riflemen recruited, on mobilization, from the personnel of the forestry department), and three companies and 25 sections of *chasseurs forestiers* assigned to fortress duty.

THE NAVY.

The Minister of the Navy is assisted by a general staff composed of three sections. The object of the first is the study of foreign naval forces and coast defenses. Among the duties of the second is to arrange for the defense of military ports, naval strongholds, metropolitan and colonial coasts, to secure coast protection by submarine-mines and to look after the torpedo and submarine flotillas. Finally, the third section superintends the preparations for military and naval operations, the mobilization of the fleet and all that concerns naval training.

Besides the general staff there is a hydrographic service comprising seven sections.

The Administration of the naval forces includes: (1) The department of the armed fleet (personnel and administrative services); (2) The building department of the fleet, comprising the branches of naval architecture, naval artillery, hydraulics and *bâtiments civils.* We must add the departments of finance and *comptabilité* (accounts), *contrôle* (keeping of muster-rolls, etc.), navigation and maritime fishing, and the establishment called *Invalides de la Marine.*

The principal schools in which the *cadres* and specialties are taught are: the Naval Academy, naval school, school for midshipmen, for torpedo gunners, for torpedo officers and engineers for sea-coast practice, for practical gunnery and steerage, for armed seamen, for paymaster cadets (administrative), for medical service, etc.

The Navy establishments outside of military ports and navyyards are the foundry at Ruelle, the artillery factory at Indret for machines and boilers, and the iron works at La Chaussade. Moreover, the Navy places some of its orders with private business concerns.

Territorial Organization.—For the administrative service of ports and the governing of young men under *inscription maritime* (naval registration) the coast of France is divided into five *arrondissements maritimes,* with headquarters at the five military ports of Cherbourg, Brest, Lorient, Rochefort, and Toulon.

Algeria and Tunis form a sixth naval district.

Each arrondissement is divided into two or three sub-districts, the latter having headquarters at Dunkirk, le Hâvre, Cherbourg, St. Servan, Brest, Lorient, Nantes, Rochefort, Bordeaux, Marseilles, Toulon, and Corsica.

Each sub-district is under a paymaster, who has charge of the *quartiers,* while in each *quartier* resides a passed assistant or assistant paymaster of the Navy, commissioner of the *inscription maritime,* who has for his special agents seamen exercising police duty in the maritime domain, also coast-guards and naval gendarmes.

A vice-admiral or maritime prefect is at the head of each of the five *arrondissements maritimes,* his authority extending along the coast line of the arrondissement and over all the departments represented within the territory that he governs.

He is assisted by a rear-admiral, chief of staff in charge of the navy-yard, a resident commissioner, a chief of naval ship-building, a chief of hydraulics, a director of submarine defenses in charge of torpedoes and torpedo-boat seacoast defense, a director of *mouvement du port* (*i. e.* of vessels entering and clearing of the port), a chief of artillery and a chief medical officer.

All these officers, except the director of vessels entering and clearing the port, form a part of the administrative council of the navyyard.

The navyyards include a central shipbuilding factory, docks, dry-docks, covered or uncovered ship-yards, magazines and workshops. They also provide storage for disarmed or reserve ships.

The reserve ships are 1st, 2d or 3d class, according as their armament fits them for setting sail in 8, 15 or 30 days.

In each of the five great military ports is a station for reserve men and *disponsibles* (unattached men) of the navy.

Sea Forces.—(a) *Personnel.*—The personnel is made up of staffs and crews.

The staffs are composed of 2,050 naval officers, 327 engineers, 153 naval ship-builders, 27 hydrographers, 253 paymasters, 344 surgeons, 54 apothecaries.

There are, moreover, 364 reserve naval officers. The crews comprise the officers of inferior rank, quartermasters, sailors, engineers, etc., numbering about 53,000 strong and assigned to duty along various lines, viz.: practical gunnery, musketry, steerage, manœuvring, carpentry, sailing, and caulking.

Naval officers are recruited from four sources: (1) From the naval school, into which, after a competitive examination, young men from 14 to 18 are received. At the end of two years they are named naval cadets, and after a year at sea become midshipmen; (2) From the Polytechnic, which furnishes four midshipmen a year; (3) From the petty officers, who, after an examination, are appointed ensigns; (4) From deep-water captains, admitted as auxiliary ensigns and who may become commissioned ensigns.

Midshipmen, after two years' service in that grade, become ensigns.

For the grade of lieutenant it is necessary to have served two years at sea as ensign, promotion being one-third by selection and two-thirds by seniority.

For the grade of commander promotion is half by selection and half by seniority, and for the higher grades of captain, rear-admiral and vice-admiral, it is now by selection only.

Recruitment.—The annual quota of naval recruits is jointly supplied by the *inscription maritime* in conjunction with voluntary enlistments and the applications made by young men to the recruiting board.

All fishermen and men engaged aboard merchant ships are on the *inscription maritime* and are bound to naval service; they number about 100,000.

Between the ages of 18 and 50, those on the *inscription maritime* are at the disposal of the State; before the age of 20 they cannot be called to active service except in case of war and by order of the President of the Republic, but once they have attained that age, if they have not entered the navy before the legal date set for such entry, they must submit to a seven years' service, including five years of active duty and two of *disponibilité* («status of men allowed to return to their homes before the completion of their full term of service»). The five years' duty includes an active service of variable length, not exceeding three years, most of the time being spent in respites, exemptions, or unlimited leave of absence. During the reserve period, the *inscrits* (those registered on the *inscription maritime*) cannot be levied unless by order of the Head of the State.

The *inscrits* enjoy certain privileges; they are exempt from the *droit de patente* (license tax), the *redevance personelle* (rent-tax), and they have the temporary grant of parts of the shore, are given pensions and receive pecuniary aid from the *Caisse des Invalides.*

The administration of the *inscription maritime* is conducted on the sea-coast according to arrondissements, sub-arrondissements, and *quartiers* in charge of naval paymasters.

There are two classes of reserves in the maritime army: (1) The reserves of the naval crew; (2) The *inscrits maritimes.*

The reserves of the naval crew are those who have voluntarily enlisted in the naval army or have been assigned to it by the law of recruitment and remain thus assigned for 10 years from the date of their entrance into the service.

In time of peace *inscrits* from 25 to 35 not in actual service may be recalled for two periods of four weeks' practice.

(b) *Vessels.*—The naval fleet comprises 35 battleships, 9 of which are in reserve, 1 is on trial and 10 are in the course of construction; 26 armored cruisers, 7 of which are in the reserve, 2 on trial and 4 in the course of building; 25 1st, 2d and 3d class cruisers, 14 of which are in reserve; 58 torpedo-catchers, 15 of which are being built; 19 gunboats, 8 of which are armored; 9 despatch boats; 9 torpedo gunboats, 40 seagoing torpedo-boats; 215 1st class torpedo-boats, 70 of which are being built; 40 2d and 3d class torpedo-boats; 39 submarine boats, 14 of which are in the course of construction, and 45 submersibles, the greater number in the course of building.

The vessels are distributed: (1) Between the squadron of the Mediterranean and the Levant; that of the North and the naval divisions of Tunis, Algeria, the Atlantic, the Extreme East, Indo-China, the Indian Ocean and the Pacific; (2) Between 14 torpedo flotillas: 2 of la Manche, 3 of the Ocean, 5 of the Mediterranean, 2 of the China Sea, 1 of the Indian Ocean and 1 of the Atlantic. Besides the torpedoes, which vary in number, these flotillas generally carry 1 torpedo gunboat and 1 or 2 torpedo-catchers. (3) Between 6 submarine flotillas: 2 of la Manche, 1 of the Ocean, 2 of the Mediterranean, and 1 of Cape St. Jacques Saignon, an important *point d'appui.*

Submarine mines, batteries, lines of torpedoes, etc., protect these *points d'appui* of the fleet which serve as a base of operations and are Cherbourg, Brest, Lorient, Rochefort, Toulon, Bizerta (Tunis), Saignon, Fort de France (Martinique), Diego Saurez (Madagascar).

Finally, the coasts are protected by 12 ironclad coast defense vessels. To the ships heretofore enumerated we must add 11 gunboats, 9 torpedo launches, 12 transports, 6 *aviso* transports and small vessels used for port service, stations and schools.

The number of guns on board the different vessels of the fleet is about 3,700.

LIEUTENANT-COLONEL ROLLIN,
Of the General Staff.

16. **France—French Railways.** *Historical, 1823-1859.*—The principles underlying the present system of railways in France will perhaps be made clearer by a brief account of the several phases that have preceded it.

The earliest experiment in railroading on French soil was a line between Andrezieux and St. Etienne, intended solely for coal and freight and operated by horse traction. The grant for it was made in 1823 by a simple royal ordinance. It was a grant in perpetuity, without subsidy or guarantee. About the same time grants were made on the same conditions for several other small lines.

In 1832 the first locomotive made its appearance. This was on the line from St. Etienne to Lyons, and thenceforward passenger service was added to freight traffic.

The Government, divining the future importance of the new mode of transportation, worked out a general scheme of trunk lines and submitted it to parliament. The first debate brought out two contrary principles which were destined to clash frequently thereafter. According to the one principle the State ought to construct and operate the railways; the other principle was that of private enterprise. After some fruitless discussions several grants were made, but a financial crisis which followed forced the recipient companies to ask for a revision of their contracts. The State had to assist them, and in 1840 it guaranteed to the Paris-Orleans Company, for 47 years, 4 per cent. interest on a maximum capital of 40,000,000 francs. This was the beginning of an arrangement which afterwards became general.

The law of 1842 decided on the creation of the trunk lines radiating from Paris to, respectively, Lille and Belgium; Nancy and Strasburg; Lyons and Marseilles; the centre of France, Bourges and Toulouse; Tours, Bordeaux and Bayonne; Nantes; Rouen and Havre; and lastly from Bordeaux to Marseilles by Toulouse, and from Mulhouse to Lyons by Dijon.

The State undertook the acquisition of a part of the lands, the departments being responsible for the remainder. The State built at its own expense the embankments and other artificial works and the substructures of the stations. The companies had to furnish the permanent way and the working stock, which at the expiration of the grant were to be bought by the State at an expert valuation. The work was begun and pushed forward energetically, but in a short time a financial crisis precipitated by speculation endangered the existence of the companies. The Republican Government of 1848 proposed repurchase, which was not accepted.

The Empire from the first favored an amalgamation of the various companies, the large number of which was a cause of weakness and of inconvenience to the public. By a series of decrees it constituted the great corporations, unifying the conditions of their contracts and extending the duration of their grants to 99 years. In this way were founded the principal French systems, whose grants expire as follows: That of the Northern
of the Orleans in 1956; of th
of the Eastern in 1954; of th
and of the Paris-Lyons-Med

Feeling their position stre
panies accepted grants for
serve as feeders to the ma
1852 to 1857 more than 2,000,
expended, when a fresh fin
vened.

At the end of 1858 the
follows:

LENGTH OF LIN

In operation.........................
Granted.........................

EXPENDITUR

By the State and sundry..........
By the companies.................

1859-1875.—The situation
having become critical, the C
June 1859, induced parliamer
ments between the State and
the following nature:

In order to restore the
situation they had enjoyed
of secondary lines, the sys
divided into two sections, call
new systems. The capital a
new system received a guarant
interest for 50 years, begi
Working expenses were incl
account. Beyond a certain sur
dividend guaranteed to the o
redemption of its capital, t
net profits had to be exper
system, so as to cover par
revenue guaranteed by the
advancing the difference. Thi
named the «Overfall» (devers
advanced by the State for th
regarded as loans, the compan
on them at 4 per cent.

On the other hand it was
that after 1872 the companies
the State such portion of the
ceeded a certain fixed figure, ca
point.» This figure was dete
allow the old system a higher
first, and to ensure to the new
above the redemption charges
per cent.

If at the expiration of th
panies should prove to be deb
their working plant was to be
repayment of the sums due.
State might redeem the grant
years by paying for the remai
an annuity determined accordi
of the preceding seven years
plant was to be bought in at
tion.

Such were the chief clause
ments which enabled the compa
finances on a firm basis and t
k. yearly to their lines in operat

At the close 1875, in spite
800 k. with Alsace-Lorraine, the
eral interest,» that is, the main
the following development:

LENGTH OF LINES.

In operation	19,744 k.
Granted	26,423 k.

EXPENDITURE.

By the State and sundry	1,412 millions
By the companies	7,991 millions

To faciliate the economical construction of lines, a law, dated 12 July, 1865, had authorized the departments and communes to create secondary lines for themselves in their neighborhood. These railways, which were called «lines of local interest,» attained, in 1875, to an extension of 1,500 k., representing an expenditure of 41,000,000 francs.

1875-1883.—During the preceding period, alongside of the great companies, a number of minor companies had sprung up, such as that of the Charentes, that of the Vendée, of Dombes, of the North and East, etc.; but their position had become very much embarrassed. Several of these lines—of «general» as well as of «local interest»—were connected with the systems of the great companies. The Company of the Charentes, one of the most important among the minor organizations, showed an annual deficit of from 4,000,000 to 5,000,000 francs. The Government submitted to parliament for its ratification an agreement whereby the Orleans Company was authorized to buy up the Charentes Company, and other secondary lines, taking over their indebtedness under certain guarantees. At this particular time there was a great deal of ill-will toward the companies in parliament and the agreement was thrown out, Government being invited to introduce a repurchase bill, which was voted in 1878. The State thus acquired the Charentes Company, and several others, which formed the original nucleus of the State System. The cost was 500,000,000 francs, and it was covered by the issue of the 3 per cent. redeemable.

Since 1876 Government had been preparing a scheme for completing the railway system. Several commissions were at work on it, and in 1879 M. de Freycinet, Minister of Public Works, procured their consent to a scheme which provided for the construction of 8,700 k. of new lines, and 8,300 k. of lines granted but not yet operated, or a total of 17,000 k., within a period of 10 years.

The cost per kilometer was estimated at 200,000 francs, making a total sum of 3,400,000,000, or an annual outlay of 340,000,000 francs, a very reasonable figure compared with the outlay for the companies during the period 1855-1865, when it averaged 430,000,000 francs a year. The Freycinet Scheme, as it has since been called, refers to the whole of these new lines, together with considerable works to be carried out in the ports.

The agreements of 1879 began to be carried out at once, but the operation of the first lines showed a deficit, which, added to the cost of constructing the new lines, considerably increased the burden on the State. It became necessary, therefore, either to proceed more slowly with the work, or else to have recourse to a financial operation to ensure the completion of the proposed lines.

Owing to a recent crisis it did not seem feasible to make a loan. The State accordingly fell back on the credit of the companies, and the Government, in spite of lively opposition, succeeded in 1883 in carrying through parliament a fresh set of agreements which regulate the French railway situation to-day.

The main features of these agreements may be summarized thus: (1) The companies accept the grant of about 1,200 k. of new lines. They undertake to supply, in addition to the working stock and plant for these lines, a sum of 25,000 francs per kilometer, the rest of the cost falling on the State. The companies agree to carry out the works according to plans approved by Government and to advance the necessary funds which shall be repaid by annuities. (2) In regard to guarantee the previous distinction between the old and the new systems is done away with. There is only one account for working expenses. The net proceeds from this account are assigned by each company to the service of its debt and to the payment of a guaranteed minimum dividend. If there is a deficiency, the State gives its guarantee. If there is a surplus, it is used for the repayment of the advances made by the State as guarantee, and after the extinction of that debt it goes to the shareholders until the dividend touches a figure known as the «reserved» dividend, after which the profits are divided in the proportion of two-thirds for the State and one-third for the company. (3) With a view to reducing the amount of the annuities guaranteeing the interest, the companies are authorized to carry over till a fixed time the deficits on new lines to a special account, called «Account of Partial Operation,» where the deficit is covered each year by an issue of bonds. (4) A settlement was carried out in respect of the «Initial Outlay» account of the old systems, and also of the value of the stocks, on 31 Oct. 1882. However, the companies may still, by obtaining a simple ministerial authorization, execute supplementary works and charge them to Initial Outlay. (5) The companies which had used the guarantee of interest under the agreements of 1850 liquidated their debt by constructing works up to an amount agreed upon. (6) The State reserves the right of repurchase at any time. Lines which have not completed 15 years' existence are to be valued according to the actual expenditure on them, and the same rule holds good for supplementary works. In regard to the other lines, an annuity is to be paid, determined, as under the agreements of 1859, by the net profits of the last seven years, the guarantee of interest being included. (7) Finally, the companies agreed to a considerable reduction of the passenger rates, and further promised to revise and unify the slow freight tariffs.

The brilliant situation of the companies in 1883 had raised the hope that the burden of the guarantee would not weigh too heavily on the budget. But a period of depression followed the prosperous years, and it was necessary, in order to reduce the expenditure, to proceed more slowly with the works. Accordingly the completion of the proposed lines seems deferred to 1908 or 1910. Subsequently the receipts gradually rose, and in the last few years the calls on the State guarantee have been decreasing; some companies have even begun repayment. However, it is to be feared that the fresh out-lays imposed on the companies may defer to a still distant date their entire liberation from indebtedness to the State.

SITUATION OF FRENCH RAILWAYS (OF «GENERAL INTEREST») IN 1904.

LENGTH OF LINES.

In operation	39,800 k.
Granted	42,250 k.

EXPENDITURE.

By the State and sundry	5,616 millions
By the companies	11,832 millions

Characteristics of the Present System of French Railways.—We have seen that the railway system which has prevailed in France is rather due to circumstances than to the realization of theoretical ideas.

It is a mixed system, which, while respecting the supreme rights of the State and according it a very extensive control over the companies, leaves the latter as much independence and initiative as are necessary for the proper management of their business.

The companies enjoy a monopoly and operate the lines, while the State continues to own them, and only concedes them for a limited period. Entrusted with a public service the rights and duties of the companies depend on contracts made with the State, which exercises over their management a threefold control, financial, technical and commercial, in virtue of the threefold character of the railway system. The exercise of this control comes under the powers of the Minister of Public Works, who is assisted by various commissions, according to the nature of the questions at issue. The most important of these commissions is the Advisory Railway Board, whose functions are chiefly commercial.

Financial System.—The financial system of the companies is regulated by agreements, viz.: Those of 1883, which are actually in force, and of which the details have been given above. The State, having refused to divest itself of its proprietary rights over the railways, and on the other hand having compelled the companies to construct costly lines, has been led not only to undertake a part of the initial outlay but also to guarantee a minimum interest on the capital invested. Consequently, the State must satisfy itself as to the correctness of the companies' accounts in respect of initial outlay and working expenses, since these determine the amount of the guarantee of interest, and also of the annuity to be paid the companies in reimbursement of their advances. The State also controls the financial situation of the companies. It sees that the issues of bonds are sufficiently guaranteed, and that a right proportion is observed between the shares and the bonds. Lastly, the law of 27 Dec. 1890, places the statutes of the companies' pension funds under ministerial control.

Technical System.—The State intervenes also in technical questions. When the companies are constructing new lines, the plans and estimates must be submitted to the Minister, who has the draught verified, and sees that all the works are planned in accordance with scientific requirements and satisfy the terms of the accepted estimates. Moreover, he causes the execution of the works to be supervised. When the companies wish to improve existing lines or to increase the working stock, they must likewise submit their plans and estimates to the minister's approval. There is government control also over all regulations touching the working of the lines, over the speed of the trains, the limitation of hours of labor, and various internal matters. The railway police is regulated by the law of 1845 and the ordinance of 1846, modified in 1901.

Commercial System.—Railway tariffs affect public wealth too deeply to have escaped government control. To begin with, in the terms of contract appended to the grants, maximum tariffs were laid down for passenger and freight services; these cannot be exceeded by the companies though they may reduce them as much as they please. However, such reductions cannot come into force till they have been confirmed or approved by the minister, who has the right to withhold confirmation or only to accord it subject to certain modifications. This gives the government a means of exercising pressure on the companies in such direction as it may desire.

An elaborate method enables the minister to get information as to the seasonableness of the proposed change, and constant shifting of rates, which is so harmful to the public, is carefully guarded against. In some cases, *e. g.*, of export tariffs or transit tariffs, the ordinary regulations are modified so as to enable the companies to meet foreign competition.

Tariffs.—The terms of contract fix the maximum amount of the taxes which the railway companies are allowed to collect. That is the legal tariff. But the companies have exercised their right of introducing lower tariffs. When freight is conveyed with all the guarantees and under all the conditions laid down in the terms of contract, the general tariff is enforced. But when the public consents to some modifications of those conditions, then special lower tariffs are applied.

The tariffs are based on the rate paid per kilometer or per unit of transportation. This base may be constant, and then the rate is proportionate to the distance traversed, as happens in the passenger service. Or it may vary with the length of the journey, so as to stand, for instance, at 8 centimes for transits below 100 k., 5 centimes for those below 300 k., and 4 centimes for those beyond 300 k. Coal and mineral products were treated thus after 1863. It was a drawback of the system, however, that the rates came higher for journeys of just less than 100 k. than for journeys of just more than 100 k., and this was true also about journeys in the neighborhood of 300 k. To remove this anomaly, it was specified that in no case should the rate in one section exceed the minimum rate in the section following. This rule, however, produced an intermittent scale (barême à paliers), the rate not changing for a number of kilometers.

To get rid of this defect in turn it was decided to adopt the Belgian tariff, so-called because it first came into general use in that country. Here the base varies only when you pass from one section into another. Thus, to return to our previous figures, the first 100 k. are reckoned on the base of 8 centimes, the next 200 k. on the base of 5 centimes, and those beyond on the base of 4 centimes. So that we get a diminishing base. The Belgian system is commonly used in France to-day both for rapid and for slow freight; but such has not always been the case.

At first the tariff had a fixed base, but in order to encourage this and that special traffic the companies introduced for certain freights and between certain stations fixed rates called «steady rates» (prix fermes), lower than those called for by the general tariff. The number of these «steady rates» increased so rapidly, however, that the handling of the tariffs was much complicated. Moreover the principle involved in the «steady rates» was much attacked. Accordingly, after the agreements of 1883 the companies proceeded to recast their tariffs. They were simplified and partly unified; freights were divided into six series; the diminishing base of the Belgian system was adopted; and a slight reduction of rates has been the general result.

However, the «steady rates» have not yet altogether disappeared, for they meet a real need, but their number is much smaller.

Economic and Financial Results of the Agreements.—The Question of Repurchase.—Under the agreements of 1883 the railways of France have attained to a development which seems not far removed from the limits imposed by the nature of the soil and by existing economic conditions, and beyond which they could not perhaps be profitably worked.

For each thousand inhabitants in France there is 1.26 k. of railroad, while England has only 0.86 k., Germany 0.94, Belgium 0.97, and the United States 0.41. Thus France has the lead in this respect. In proportion to area France has 9.2 k. of road for each square myriameter (=6 miles 1 furlong 28¼ poles); England, 11.5; Germany, 10.0; Belgium, 22.7; and the United States, 4.3. Here, even setting Belgium aside, the order is reversed.

It must be remembered that, owing to the very variety of the regions traversed by them, the several lines of the French system show marked differences in the importance of their traffic. To become convinced of this one only has to glance at a map on which the thickness of the lines is proportioned to the gross receipts by kilometer. There one will quickly perceive a number of great arteries standing out clearly. These constitute the nuclei, as it were, of the great companies, and they are connected together by a network of other lines mostly slender, and with meshes which are larger or smaller according to the nature of the districts they cover. If the creation of the lines had been left entirely to the initiative of the companies, it is certain that the principal arteries would long have remained the only routes opened up, while their ramifications would have been constructed but slowly. It was the influence of the agreements which enabled the less productive lines to be opened and operated.

From the financial point of view the most important result of the agreements has been the consolidation of the companies' credit. In some instances it has made it possible for them to borrow at lower rates than the State itself could have done. But as the increase of their capital made their indebtedness more burdensome, and on the other hand the operation of new lines caused a deficit, they were obliged to call on the guarantee of interest for sums which before the conventions of 1883 amounted to 545,000,000 francs, and between 1883 and 1903 rose to 951,000,000 francs.

It must be borne in mind, however, that although the sums asked for under the guarantee appear each year among the outgoings of the budget, they are in fact loans bearing interest at 40 per cent. and secured by a valuable working stock; that is to say, they are really very good investments for the State.

Another outcome of the agreements has been that the State has had to liquidate part of its debt. The companies having advanced some of the funds for initial outlay, the State pays them back with annuities of which the sum total is usually much larger than that of the guarantee—evidently an excellent operation for the State.

Moreover, to get an exact idea of the influence of the companies on the budget, one must offset the outgoings with the receipts and savings secured to the treasury by them, which the administration reckoned as follows for 1904:

EXPENDITURE.

Interest on capital borrowed directly	129	millions
Annuities to companies, capital supplied by them	92	millions
Guarantee of interest	27	millions
Costs of control	5	millions
Total	253	millions

RECEIPTS AND SAVINGS.

Repayment of guarantee loans	5	millions
Costs of control	5	millions
Taxes on transportation	108	millions
Shares and bonds	57	millions
Savings for the public service	95	millions
Total	270	millions

These figures leave out of count the guarantee of interest for lines "of local interest."

Thus the account would be found to give a balance of 17,000,000 francs in favor of the State.

The financial position of the companies has distinctly improved of recent years; three of them have entered the stage of repayment, and one, the Northern Company, has never had recourse to State subsidies. If events follow a normal course, one may legitimately expect this improvement to go on increasing progressively, and one may look forward to a time when most of the companies will be free of all indebtedness toward the State.

A glance at the manner in which they discharge their task will show that their «coefficient of operation» is lower than that in any other country, and that on most points they will bear comparison favorably with the best foreign companies. In particular, French engines have been the subject of the most flattering criticisms both in England and in America.

In these circumstances what motives could be strong enough to induce the State to involve itself in the task of repurchase? It is evident from the parliamentary history of French railways that the question has nearly always been regarded from a point of view quite foreign to economics and financial questions. And this seems to be the case to-day.

In reality, State operation of the railways finds few supporters among competent men, and the example of countries adjoining France, where the railways are nationalized, is by no means conclusive. In these very countries indeed the French system has more than once been quoted as a happy union of public powers and private initiative. Consult particularly 'La politique francaise des Chemins de fer,' by R. von Kaufmann.

The highest authorities have always been of opinion that repurchase in existing conditions would be a disturbing operation for the public finances; whereas by the mere action of the agreements the State must necessarily, in the middle of the century, come into possession of a completely developed and liquidated system, and that without opening its purse. It might then dispose as it pleased of the net income of the railways which already amounts to more than 700,000,000 francs, and ought by that time, it has been calculated, to be more than 1,000,000,000 francs. Such will be the final outcome of the agreements, if they succeed in weathering the violent attacks which are once more being made on them.

Statistics.—The development of the lines and the paid-up capital by decades was as follows:

Years.	Length of the lines in operation up to 31 December.	Corresponding Capital of Initial Outlay.
	In kilometers.	In mill. francs.
1830	38	6½
1840	435	146
1850	3,010	1,363
1860	9,439	4,726
1870	17,440	8,168
1880	23,738	11,065
1890	33,550	14,271
1900	38,122	16,442
1904	39,200	17,442

The division among the several companies in 1904 was as follows:

Company.	Average length in operation during the year.	Capital Enlisted		Shares and Bonds issued by the Companies.	
		Expended by the Companies.	Subsidies.		
	Kilometers.	Millions	Millions	Shares.	Bonds.
Nord	3,765	1,711	100	525	4,425
Est	4,857	1,577	671	584	5,447
Ouest	5,829	1,785	793	300	5,750
Orléans	7,384	1,976	861	600	6,264
P. L. M.	9,288	4,024	1,009	800	13,024
Midi	3,764	1,090	552	250	3,820
Ceintures	173	93	26	215	567
Petits Réseaux	1,392	835			
Etat	2,916	843			
Total	39,200	17,442		3,274	39,298

RECEIPTS, EXPENDITURES AND NET PROFITS.

Years.	Gross receipts with tax taken off.	Working expenses.	Net profit.	Coefficient of operation.	Rates of remuneration on the capital.
	Millions.	Millions.	Millions.	Per cent.	Per cent.
1841	13	8.3	4.7	64	
1850	96	45	51	47	3.75
1860	418	188	230	45	4.87
1870	634	313	321	48	3.95
1880	1,061	538	523	50	4.75
1890	1,154	607	548	51	3.85
1900	1,517	824	693	54	4.10
1904	1,515	787	728	52	4.20

The division for 1904 among the different companies was as follows:

Company.	Gross receipts with tax taken off.	Working expenses.	Net profit.	Coefficient of operation.	Rates of remuneration on the capital.
	Millions	Millions	Millions	Per cent.	Per cent.
Nord	239	128	111	53½	6.19
Est	192	108	84	56¼	3.73
Ouest	192	108	84	56¼	3.26
Orléans	236	111	125	47	4.4
P. L. M.	459	217	242	47¼	4.80
Midi	116	54	62	46½	3.75
Ceintures	16	15	1	94	0.84
Etat	52	38	14	73	1.66
Petits Réseaux	13	8	5	61½	0.6

In these two tables the coefficent of operation is the relation of working expenses to gross profit. The rate of remuneration on capital has been determined by comparing the net profits with the capital of establishment. The liquidation charges on the capital are not taken into account.

Traffic.—The progressive development of traffic and lowering of rates from 1841 to 1904 was as follows:

Years.	Total distance covered.		Mean tariff per kilometer.		Mean receipts per kilometer.
	Passengers.	Freight.	Passengers.	Freight.	
	Millions of k. passrs.	Millions of Kilometric tons.	Centimes.	Centimes.	Francs.
1841	112	38	7.00	12	26,000
1850	797	462	6.66	7.7	32,700
1860	2,921	3,120	5.64	6.92	45,600
1870	4,272	5,057	4.95	6.14	40,800
1880	5,863	10,350	5.04	5.95	46,000
1890	7,943	11,759	4.40	5.46	35,000
1909	14,063	16,557	3.67	4.69	39,800
1904	13,699	16,551	3.70	4.60	38,000

Division among the companies of the traffic for 1903 was as follows:

Company	Total distance covered.		Mean tariff per kilometer.		Mean receipts per kilometer.
	Passengers.	Freight.	Passengers.	Freight.	
	Millions of k. passrs.	Millions of Kilometric tons.	Centimes.	Centimes.	Francs.
Nord....	1,998	3,401	3.83	3.86	63.671
Est......	1,804	2,276	3.40	4.40	38,917
Ouest....	2,180	1,325	3.60	5.45	32,792
Orléans...	1,988	2,402	3.66	5.01	32,171
P. L. M...	3,480	5,298	4.09	4.57	49,292
Midi.....	1,024	1,221	3.56	5.09	31,381
Ceintures.	216	113	3	7.38	30,000
Etat.....	556	466	3.13	5.14	17,654
Petits Réseaux..	87	82	4.03	8.68	5,651
Total....	13,335	16,585	3.70	4.63	38,489

The number of kilometric passengers or tons, is the sum of kilometers covered by each passenger or by each ton of freight.

M. de Saint Amand,
Engineer to the Chemin de Fer du Nord.

17. **France—French Industries.** In order to study French industries methodically we shall divide them into four classes: (1) Great Industries; (2) Small Industries; (3) Domestic Industries; (4) Agricultural Industries.

I. *Great Industries.*—In the first rank of great industries stand the textile industries, which really include cotton, wool, lame, flax, hemp, and jute, and also a certain number of secondary industries, each one of which consists of two principal branches—spinning and weaving. To avoid mistakes we shall examine them separately.

(1) The cotton industry consists of spinning-mills containing 6,150,000 spindles and 108,000 power looms. Spinning-mills are confined to three centres: Normandy, where they are in the vicinity of Rouen; Nord, where the centres of Lille and Roubaix stand out prominently; and Vosges, including the department of the same name; Meurthe-et-Moselle and the Territoire de Belfort. Weaving, on the other hand, is much more extended, and can be divided according to specialties into 16 districts: (1) Amiens, ribbed velvets; (2) Condé sur Noireau, striped cotton; (3) La Ferté Macé, coutils of various designs; (4) Flers in Orne, stripes and oxfords; (5) Evreux, corsets and bed linen; (6) Haute-Saône, striped weaves; (7) Mayenne, specially for what is called Laval; (8) le Nord, flannels, bedquilts and sateenes; (9) Normandy, shirtings and long-cloth; (10) Paris, napkins and Turkish toweling; (11) Roanne, blue cotton goods; (12) Tarare, muslins and hand embroideries; (13) Thizy, cretonnes and peruviennes; (14) Saint-Quentin, mousselines and gauzes for furnishing; (15) Vosges, cotton-cloth and satinet; and (16) Troyes, cotton hosiery.

(2) The wool industry uses 1,600 heckling-machines of different styles, 2,000,000 spindles in combing mills, 390,000 spindles in the spinning mills of carding, and 55,000 power-looms. A certain number of these looms are used by turns for cotton and for wool. The wool-carding mills are most important and form a separate industry. They are situated in Roubaix and in Reims, and the shoddy-mills are in Elbeuf and Vienne. The representative spinning-mills are at Roubaix, Fourmies, Reims, Vienne and Belfort. As for weaving mills, they have 15 different centres: (1) Amiens, noted for serges called du Barry; (2) Saint-Quentin and Bohain cashmeres and light novelties; (3) Beauvais, tapestries; (4) Tours, blankets; (5) Elbeuf, cloth; (6) Fourmies, colored and mixed weaves; (7) Lisieux, printcloth; (8) Louviers, novelty goods; (9) Mazamet, curried fustians and military cloth; (10) Paris, double-milled goods and sateenes for uniforms; (11) Reims, merinos; (12) Roubaix and Tourcoing, novelties for dresses; (13) Sedan, cloth for clothing; (14) Vienne, novelties for ready-made suits; (15) Vosges, articles for footwear. The wool industry of France is considered the most important in the world.

(3) The silk industry consists of 13,000 bassines for separating the threads from the cocoons, 35,000 power-looms for weaving, and 35,000 hand-looms. The silk mills are situated in Cevennes and Gard; silk is made both by machine and by hand in Rhône and the neighboring departments, and the principal centre for selling it is at Lyons; for ribbons the chief centre is Saint Etienne; and for galoons, laces for shoes, etc., and braids, Saint Chamond and Izieux. A new industry—artificial silk—was first made in 1889 by Chardonnet, its chief centre being Besançon.

(4) Flax and hemp, together with jute, contain—in all their factories—500,000 spindles; and in weaving, 22,000 power-looms and 20,000 hand-looms. The flax-mills are chiefly situated in Nord; the manufacture of thread called «sec» (dry) is in many respects like that called «mouille» (wet). Sewing thread of flax is also made in the same section of the country. As for woven goods, strictly speaking, their manufacture is divided into a certain number of groups, that can be classed as follows: (1) the factories of the Nord, the chief centres of which are Armentieres, Lille, and Bailleul, where smooth goods, colored or white, are made in every width; Dunkerque, Beauval and Flixecourt manufacture jute goods, and several places in Somme awnings and damask; (2) Normandy is celebrated for shirtings, pillow-cases and table covers; (3) Brittany and Anjou for handkerchiefs, canvas, etc.; (4) Vosges for table and bedroom linen; (5) South for coarse cloth. We may add that in all these sections «ramie» silk is manufactured.

It is estimated that the textile industries, properly speaking, employ 825,383 workmen in France, furnishing occupation to 1,053,588 workers on suits and other garments. They also feed as many cotton as silk mills. 2,076 tulle looms are working in Caudry, Calais, Saint Pierre and Lyons. This is the official account of the hosiery business in flax and in wool in Somme, Nord, and Vosges; in cotton in Roanne and Troyes; and in silk in Hérault, Gard and Hautes-Pyrenées. Hand-made lace forms one of the most artistic industries of Puy, Bailleul, Bayeux, Mirecourt, etc. Besides these there are innumerable embroidery factories in successful operation in Saint Quentin, Angers, Tarare, and Nancy, and of passementeries in Lyons, Nimes, and Paris.

(5) After the textiles, the industry which employs the most men in France is the mining of coal. The coal mines are divided geographically into five districts: (1) the coal mines of the North, covering a surface area of about 109,000 hectares, distributed in the departments of Nord and Pas de Calais, in about 40 grants, the chief of which are those of Anzin, Vicoigne, Noeux, Bethune, Lens, Aniche, Marly, etc.; (2) the coal mines of the East, principally near the Moselle, to which are joined the mountainous branches in Savoie where anthracite coal is found; (3) the coal mines of the Oise, which include the basins of Basse-Loire, Vendée, etc.; (4) the coal mines of the centre, the most important after those of the North, which include the basins of Saône et Loire (Autun, Creuzot, Blanzy, Montceaux, Montchanin 875 hectares); those of Allier and Auvergne (Ahun 2,200 hectares; Commentry, 2,480, etc.); those of Loire (Saint Etienne, Saint Chamond, Rive de Gier, Firminy), with a surface area of 25,000 hectares; those of Savoie and Loire, 42,972 hectares; of Nievre, 8,000 hectares; of Allier, 7,367 hectares; of Correze, 5,432, etc.; (5) the coal mines of the South, situated near Lot, Hérault, Gard, which contains several basins, two of which are exceedingly important—that of Aveyron, 12,000 hectares, and Gard, 26,888 (Grand Combe, Besseges, Alais, etc.). Besides these, there are in Hérault the small basins of Neffiez, Ronjan, Graissessac (8,800 hectares), and Bousquet d'Orb (15,129 hectares), and in Tarn, the basins of Carmeaux (8,800 hectares). To coal mining there is always attached the secondary industry, the manufacture of coke and agglomerates.

The great mineral industries of France are naturally near the coal deposits. The only way they can be divided geographically is under the same divisions as the coal mines. But the chief centres can be especially noticed as follows: in Besseges (in Gard) where there are iron mines, are blast-furnaces, foundries, machine-shops, turning-plate factories, smelting works, etc.; Commentry-Fourchambault has blast-furnaces, forges, foundries, wire-mills; there are machine-shops for the manufacture of steel at Montlucon and at several points where these manufactures are exported, extending through Cher, Allier and the Nievre; at Creusot there is one of the most important metallurgic establishments in the world, which is situated in the centre of France. Henrichement is joined to the railway of Bourgogne and Bourbonnais and connected with the canal du Centre by a private railroad. Decazeville is the most important metallurgic centre in the South; here are made rails, various iron merchandise, cast-iron pipes for conduits, boilers, etc.

There are factories in Fives-Lille (Nord) and Givors (Rhone), chiefly making machinery used in the manufacture of silk and plush, steam-engines, locomotives, materials for constructing railroads, pig-iron, and heavy metal work, etc. Indre, in the department of the Loire, makes a specialty of marine constructions, torpedoes, large pieces of cast-iron boilers, etc. In Maubeuge (Nord) are the most important metal works; and there are others in Longwy (Meurthe-et-Moselle), both near Belgium; and in Montataire, which contains other factories besides the one of that name; then comes Creil, celebrated for its parquet flooring, and the remelting of old iron, extensively used in the manufacture of tin; and then again the factories of Frouard, near Nancy, Bagugson in Meuse, and Outreau (near Boulogne sur Mer); Rive de Gier is an important centre for foundries, the manufacture of steel, steam-engines, wheels, and materials for building railroads; Saint Chamond, especially is celebrated for the rolling of iron and steel; and lastly comes Terrenoire, where the pig-iron of Ardeche is made into iron.

The glass industry is brilliantly represented in France. Besides the manufacture of bottles carried on in the glass works of Blanzy, Rive de Giers, Givors, Saint Galmier, Vauxhot, Reims, Epernay, Fourmies, Valenciennes, and some localities in the Jura, mention may be made of the celebrated factories for making plate glass in Aniche (Nord), Chauny and Saint Gobain (Aisne), and those for making cut glass in Baccarat (Meurthe-et-Moselle), where the industry has reached great artistic excellence, in consequence of which a considerable amount is exported.

Mention should also be made of the chemical works for the manufacture of sulphuric acid and soda. These have warranted the erection of quite large buildings; for instance, the chemical works in the North, the works in Saint Gobain Malétra, etc. At all these places there are mineral deposits. Other industries of a chemical character can be included in this group, like that of coloring matter, the most representative of which are Saint-Denis and Rhone; fecula and amidine works, which are all in Nord; white lead, made in Nord and in the vicinity of Paris; tallow candles, chiefly made in the departments of the Seine, Rhone, Hérault, and Bouches du Rhone; dyeworks, always located near textile factories.

Ceramics are among the great industries of France. The manufacture of porcelain is especially centred in Limoges; square tiles in Maubeuge, faïence in Choisy le Roy, Gien, etc. In this group can be classed the manufacture of cements in Boulogne sur Mer, and in the outskirts of Grenoble; and the mining of asphaltum principally found in Savoie.

We can also count among the great industries of France the manufacture of machine-made boots and shoes in Blois, Fougeres, etc.; writing pens and pencils in Boulogne sur Mer; clocks in Besançon; marble-cutting in Cousolre; cutlery in Chatellerault; perfumery in Paris and in Grasse; gloves in Grenoble and its environs; soap in Marseilles and in the North; hats in Lunéville, Paris, etc.; the picture trade in Tours, Epinal, and Paris; the most celebrated manufactures of automobiles in the suburbs of Paris, etc. Certain specialties, such as stalls, on some of which the French have a monopoly, are made in large quantities, and there are a great many tobacco and match factories. Arms are manufactured in Saint Etienne, cannons in Bourges, and tapestries (Goblins) in Paris.

II. *Small Industries.*—The principal small industries for which the French are especially noted—on account of the taste they have shown for this kind of manufacture—are «Articles de Paris,» so called because manufactured in that city or its suburbs. They can be divided into 13 groups: (1) the toy trade—dolls, dressed and undressed, mechanical toys, various games, all kinds of playthings, heads for modistes, cotillon favors, masks, etc.; (2) the manufacture of buttons in horn, bone, vegetable-ivory, papier verni, hardwood, etc.; (3) pasteboard articles, such as bonbon boxes, and all decorative pasteboard articles; (4) false hair and hair work, the demand for which has greatly increased owing the present style of coiffure worn by women, which requires much false hair; (5) fans, certain kinds of which are manufactured in the vicinity of Beauvais; (6) artificial flowers, many of which are exported; (7) the sheath trade, which includes the manufacture of knife boxes, cases for spoon, fork and knife, cases for surgical instruments, pipes, cigars, opera glasses, cases of white manna-ash, and especially jewelry cases; (8) the manufacture of workboxes, which includes certain small articles used by children as playthings; (9) umbrellas, parasols, and horsewhips; (10) combs in horn, buffalo-horn, real and imitation tortoise shell with hinges, gilt backs, carved, inlaid, etc.; (11) feathers, which are chiefly worn on women's hats; (12) portfolios and morocco leather work, which is an industry distinct from sheath-making; (13) fancy articles, such as billiard balls, crucifixes and other religious objects, in ivory or in wood, mountings for canes, lunettes, opera glasses, lorgnettes, knife-handles, games of dominoes, toilet articles, and articles used by smokers, etc.

Let us mention, as essentially French, the industries that owe their existence to fashion, in which Paris reigns supreme, the term «Mode de Paris» being used in many foreign countries to make their productions sell. It is especially the workwoman herself who invents, modifies, improves, and, trying the effect on herself, chooses the best and calls it a new mode. In this industry, ratan, wire, and whalebone are used for forming and supporting hat frames, and these are made in the ordinary factories; the modistes, strictly speaking, select and arrange the materials, flowers, feathers, and laces.

The goldsmith's trade also takes a high rank in France, especially in Paris, not only on account of the large goldsmith shops that make only large pieces—all silverware used to ornament the table and buffets—but also the small goldsmith's shops that make a specialty of knives and forks for fish, mugs, sauce-pans, knives and various kinds of utensils, and also religious goldsmith work, such as brass and pewter plates. To this industry can be added that of argentry, for which certain Parisian firms have acquired quite a reputation.

III. *Domestic Industries.*—Although domestic industries are very prominent in France, it is difficult to locate them, because in so many places they are annexed to the great industries. For example, in the textile industries, a certain number of localities, such as the environs of Lille and the manufacturing town of Cambrai, flax-linen has its home; the workmen use all their skill to get suitable thread from their employers, and then, after weighing it, they take it home; so also in Saint Etienne, the manufacture of silk ribbon is made in great part in the homes of the workmen, whose looms work by electricity controlled from a central factory from which the power is distributed; the same is the case in the entire lingerie industry, concentrated in Saint Omer and in Vosges, the work being taken home under the direction of forewomen and contractors, as is almost all the lace manufactured in Bailleul, le Puy, and other localities; and much of the labor of the 1,000 mouselenne de coton factories in Tarare. The large stores where ready-made clothing is sold have in their employ many men and women who do the work at home. In the small industries, as well as in the large, part of the work can be done in the homes of the workmen. For instance, all varieties of «Articles de Paris» are usually made away from the factories.

Besides these branches of the chief centres, there are other industries that may be considered as family industries in the sense that the manufacturer needs only one, two, or three workmen at most on each article, like real or imitation jewelry, the manufacture of effervescents, pharmaceutical specialties — many of which are exported; dyeing and scouring, etc., and numerous others.

IV. *Agricultural Industries.*—The most important of French agricultural industries is the manufacture of wines, for which France has a world-wide reputation. The departments of Gironde, Cote d'Or, Marne, Drome, Savoie, and Loire yield the most noted vintages, as well as the most abundant, but fine grapes are also grown in the departments of Hérault, Gard, Aude, Gers, Pyrenées-Occidentales, Charente, etc. They can, broadly speaking, be divided into three great classes; Bordeaux, Bourgogne and Beaujolais. Especially noteworthy are the Normandy wines, and the matchless champagne. Next in importance after wines come distilled liquors. There are two kinds of brandy, betterave (beet), manufactured only in the North and consumed there, and wine brandy exported all over the world—a sufficient guarantee of its worth. This last can be divided into three varieties: (1) cognac brandies, which are called (after the places where they are made), Fine Champagne, Borderies, Bois ordinaires, and Deuxiemes Bois; (2) Armagnac brandies, which are known by the names of Bas-Armagnac, Ténareze, and Haute-Armagnac; (3) Montpellier brandies. The first are made exclusively in the departments of Charente and Charente-Superieur; the second in Gers, Landes, Lot et Garonne; and (3) in Hérault. Besides the above mentioned kinds, in all these wine districts Mare brandy is made with the help of the Mare of the vintage, and in the department of Indre another brand of local brandies, which goes by the name of Calvados, has gained a certain reputation.

Next in importance to brandies is beer. This is not exported, but a greater quantity has been brewed in the last few years. A great many departments in France situated near the frontier have brewed beer after the German fashion so successfully that its general consumption has exceeded that of Munich and Vienna.

The manufacture of granulated sugar is one of the great agricultural industries of France. This gives rise to three different industries: (1) the cultivation of beets for the sugar contained in them, with nurseries for the scientific cultivation of seeds which are exchanged between France and Germany. These extend over the millions of hectares in the North. (2) The manufacture of beet sugar in Nord, Aisne, Somme, and many northern departments that have refineries annexed. (3) The refineries of colonial sugar, which is imported and made into sugar in the ports.

Besides these great manufactures, that form the base of French agricultural industries, we might mention a great many more that are developing rapidly; as the preparation of chickory in Nord, successfully used with coffe; the digging of peat in Somme, used instead of coal; the manufacture of olive-oil in all the southern departments; that of wax and honey which has been greatly extended in the eastern portion of France; butter, which has necessitated the erection of large factories in the district of Avesnes (Nord); the manufacture of biscuits at Marseilles, Nantes, Bordeaux and Suresnes, etc.; chocolate manufacture; glue manufacture, etc.

The manufacture of agricultural machines is an important industry, and notwithstanding the competition of American machines, the making of heavy implements like threshing-machines is carried on on a large scale, especially in Liancourt, Fumay, Vierzon, Dourdan, and Algeria.

Alfred Renouard,
Editor of "l'Industrie Textile."

18. France — Commercial and Banking System. The history of French commerce and industry, like the history of France itself, naturally falls under two heads: the old *régime* and modern times.

Previous to modern times, the development of French industry was limited by the guild-system on the one hand, and on the other by the numerous obstacles, inherited from feudal times, which lay in the way of exchanges from one province to another. Many of those obstacles were still in existence on the eve of the Revolution. However, a progressive element was to be found, ever since Colbert's days, in the royal manufactures. They did not belong to the king, but were protected against the guilds' monopolies by privileges conferred by the crown. We may mention among them the tapestry manufactures of the Gobelins and of Beauvaris and the porcelain factories of Sèvres. The private factories of Aubusson (tapestry); Rouen, Marseilles, Lunéville (earthenware); Lyons (silk), and the glassworks in the Dosges — where glassworkers were long styled *gentilshommes verriers* — also deserve notice.

Foreign commerce was effected principally through the French ports; Marseilles, where the tradition of commercial navigation is as old as the town itself; Dieppe, the birthplace of the famous Angot, and the harbors of the Atlantic, which sent out ships to the New World; the old French colonies in the West Indies; Louisiana, Canada, and the Indian Ocean are witnesses to their activity. The establishment of the *Compagnie des Indies* (1664) shows us the metropolis taking an interest — unfortunately one too weak and too fugitive — in commercial matters. The reader may also be reminded that the commerce between England and France which, if circumstances had been different, might have developed under the treaty of 1786, was at stake throughout the long duel fought by the First Consul and the Emperor against the English people.

The home commerce was necessarily purely local; the means of communication being strictly limited to the rivers, the few canals, and fewer good roads; the towns were compelled to be self-supporting, and the country people had to depend, both for their food and their clothes, on the produce of their labor and on the housewives' industry.

Before the middle of the 19th century the new canal and road systems and the railway and telegraph lines had given an incalculable power to the latent forces of the country, bringing about a complete transformation of industry and commerce. We may here notice that the impulsion thus given to commerce and industry never equalled in France that which made itself felt in England and in America about the same time.

Among the principal characteristics of the commercial revival of the 19th century, we must mention the specialization of goods, the indefinite extension of the fields open to manufactures, a considerable increase in the cash balances and clearing-house statistics, an ever-growing demand for capital and its tendency to concentration and association. Henceforth we see, more and more frequently, societies taking the place of individuals, and joint-stock companies substituting themselves to the ordinary copartnerships (those among the latter which have sleeping partners bear the name of *sociétés en commandite*). The coöperation just mentioned was in France as elsewhere of more frequent occurrence among manufacturers than among tradespeople, and there exists in France in the towns and in the villages a large class of small retailers which have the political strength to destroy any great combination that might attempt to drive it out of the market.

As early as the beginning of the modern period, the government had encouraged industry and commerce and given them the institutions they wanted. The *Code de commerce* was issued in 1807. In order to entrust its application to fully competent magistrates the French produced a unique and admirable system of *commercial courts*. The judges of these are returned by an electoral body exclusively composed of those subject to their jurisdiction. Jurisdiction of *Prud'hommes* was organized on the same lines, finally the Chambers of Commerce, to be elected very much in the same way as the courts, were instituted (1803), their functions being to look after the general interests of trade, to advise the public powers when requested, and to lay before them the desiderata of the trading classes. Important rights were conferred upon these Chambers of Commerce, including that of raising certain taxes. One of the most useful works undertaken by the Chambers of Commerce has been their contribution to the organization of commercial education in France. So far that education was practically nonexistent; at the present time it is still comparatively little spread. It is only given in special schools where pupils are admitted after completing their general education.

The interference of the government makes itself felt in another way, more prejudicial than favorable to the expansion of trade, namely by the manifold regulations which are constantly claimed by the working class. The government also has to regulate the system of customs which is largely based on the principle of protection, in France as elsewhere favorable to some producers and a source of grave difficulties to others.

It is practically impossible to give a numerical estimate of the amount of business transacted in France. Mr. Maurice Block put it at 1,000f. ($200) per inhabitant in 1875. It would certainly be more now, even without including the business carried on at the Stock Exchange; to give an example of the latter it was estimated in 1888 by Mr. Neymarck that the stocks negotiated on the Paris Exchange alone reached a yearly total of from 30 to 35,000,000,000f.

As to importation and exportation, the following statistics will give an idea of the commercial movement in France. We first extract a few figures from the tables drawn under Louis XVI. by Arnould, *chef du bureau de la balance du commerce.*

EXPORTATION FROM FRANCE TO HOLLAND.

	EXPORTATION FROM FRANCE TO HOLLAND.
1658	72,000,000 f.
1716	31,000,000
1787	46,000,000

	IMPORT FROM ENGLAND INTO FRANCE.	EXPORT FROM FRANCE INTO ENGLAND.	TOTAL.
1686	18,000,000 f.	23,300,000 f.	41,300,000 f.
1716	13,900,000	8,000,000	21,900,000
1787	58,600,000	37,600,000	96,200,000

We may add that the total importation of France in 1787 seems to have reached from 400 to 500,000,000f. as against somewhat less than 100,000,000 in 1716, and the total exportation at the same date from 50 to 500,000,000f. as against a little over 100,000,000f. in 1716. The imperial policy considerably reduced our exchanges with foreign countries, especially with England, with the effect that even under the ultra-protectionist government of the Restoration the figures representing our imports and exports hardly equaled those reached during the last years of the old *régime.*

In the following columns we give the yearly average reached by the *commerce général* and the *commerce spécial* respectively during the five ten-years' periods from 1827 to 1876. (The *commerce général* includes all imports and exports of any sort, coins excluded· the *commerce spécial* only includes among imports foreign goods meant to be consumed in France, and among exports goods wholly or partly manufactured in France and sent to foreign countries. The sums given represent millions of francs.)

	COMMERCE GÉNÉRAL.		COMMERCE SPÉCIAL.	
	IMPORT.	EXPORT.	IMPORT.	EXPORT.
1827–1836	667	698	480	521
1837–1846	1,088	1,024	776	713
1847–1856	1,503	1,672	1,077	1,224
1857–1866	2,987	3,293	2,200	2,430
1867–1876	4,262	4,202	3,408	3,307
1877	4,570	4,371	3,670	3,436
1878	5,089	4,112	4,176	3,180
1879	5,579	4,270	4,595	3,231
1880	6,113	4,612	5,033	3,468
1881	5,996	4,724	4,863	3,561
1882	5,962	4,764	4,822	3,574
1883	5,887	4,562	4,804	3,452
1884	5,239	4,218	4,343	3,232
1885	4,930	3,956	4,088	3,088
1886	5,117	4,246	4,208	3,249
1887	4,943	4,238	4,026	3,246
1888	5,187	4,298	4,107	3,247
1889	5,320	4,803	4,317	3,704
1890	5,452	4,840	4,437	3,753
1891	5,938	4,730	4,768	3,570
1892	5,136	4,551	4,188	3,461
1893	4,951	4,326	3,854	3,236
1894	4,795	4,125	3,850	3,078
1895	4,920	4,589	3,720	3,374
1896	4,929	4,593	3,799	3,401
1897	5,137	4,803	4,000	3,676
1898	5,583	4,673	4,472	3,511
1899	5,848	5,533	4,518	4,153
1900	3,989	5,522	4,698	4,109
1901	5,606	5,220	4,369	4,013
1902	5,699	5,597	4,394	4,252
1903	6,079	5,577	4,801	4,252

In 1909, the imports were valued at $1,152,715,000 and exports, $1,063,746,000; in 1908, imports $1,088,619,000, and exports, $974,785,000.

The revival of the French commerce and industry after the Revolution and in the course of the 19th century was bound to have its effect on the working of the banks which, being the organs of the public credit, are the natural auxiliaries of exchange. The financial system of the state has also been subjected to a complete reorganization; public works of all kinds, military expenses, etc., have brought about a considerable demand for capital; all the financial markets have come to share in the greater operations of credit and an ever closer solidarity has been established between the various financial markets themselves. The function of bankers, formerly mere money-lenders to the sovereigns, has thus evolved, being placed by circumstances on a broader basis. Hence it is true to say that, although some banking firms can proudly trace their origin several centuries back, the constitution of the banking system in France was the work of the 19th century.

The French banks are divided as follows: (1) The two official institutions, viz., the Banque de France and the Crédit Foncier; (2) the so-called "Haute Banque" and some credit societies of the same kind; (3) the other credit establishments; (4) the discounting banks. We must point out at once that, from a legal and fiscal point of view, the name of *banquiers* is officially given to financiers whose function is, in fact, that of brokers and who are designated in professional slang by the name of *coulissiers* (as though operating behind the scenes, *dans la coulisse*). The latter name was given to them at a time when they could only practice their business by tolerance, being theoretically excluded from the market by the stockbrokers' privilege.

1. The Banque de France was founded in 1799 by the First Consul and finally organized

by him, as Emperor, in 1806. Its constitution was inspired by that of the Bank of England, but not made similar to it; it belongs to the system which, with some variants, now prevails in most European countries, and is entirely different from that of the United States. The Banque de France has, to begin with, an official function, viz., the issue of bank notes, which it owes to a privilege conferred upon it by law as early as 1803 and renewed ever since (for the last time in 1897). The bank notes are balanced in metal, the sum total in gold and silver being now about 4,000,000,000f. (2,925,000,000 in gold and about 1,060,000,000 in silver); and in bills, the amount which they represent varying from 5 to about 850,000,000f. The limit of the circulation of bank notes, fixed at 4,800,000,000f. in 1897 was raised by a recent law (Feb. 1906) to 5,800,000,000f. They are recognized as legal currency. An invaluable reserve is thus secured which could easily be disposed of in a crisis — as for instance in case of war, by enforcing the currency of bank notes.

The Banque de France has, on the other hand, a commercial function, consisting in the discounting of commercial bills on condition that they bear three signatures, represent a minimum value of 5f. and can produce a minimum interest of 0f., 10c. The rate at which the commercial bills are discounted varies according to the circumstances of the money and financial markets, but the right enjoyed by the Banque de France to reimburse its notes in silver enables it to keep that rate considerably more even than is the case in countries in which gold is the only recognized standard.

The capital of the Banque de France, originally 30,000,000f., has been raised successively to 45, later on to 90, and finally to 182,500,000f. (9 June 1857), in 182,500 shares of 1,000f. each. They are worth today about 3,900f. The banque is administered by a committee of 15 régents, five of whom are to belong to the commercial or manufacturing class and three are to be taken among the *trésoriers payeurs généraux* (the representatives of the French Exchequer in the various *départements*). It has a governor and two subgovernors appointed by the government. The banque has a total of 445 branches in the country.

The following statistics will give an idea of the rate at which bills have been discounted at the banque during the last 50 years:

	MAXIMUM RATE.	MINIMUM RATE.	AVERAGE RATE.
	%	%	%
1854	5	4	4.30
1864	8	4½	6.50
1874	5	4	4.30
1884	3	3	3
1894	2½	2½	2.50
1904	3	3	3

The Crédit Foncier, the governor of which is also appointed by the government, has an organization very similar to that of the Banque de France. Its special function consists in granting first mortgage loans to persons, villages, towns, and *départements*. The Crédit Foncier appeals to the public for the funds necessary to its operations by issuing bonds called *obligations foncieres* or *communales*. It has a capital of 200,000,000f.

2. The firms which compose the *Haute Banque* are often older than the Banque de France itself. We find them at the origin of all great modern enterprises: their heads were the founders of the Banque de France and of the great railway and insurance companies and their successors still have seats in the councils of both. The government rewarded their efforts at the time by creating among them the *barons de la finance*. Most of them have kept up the tradition and occupy an important place in the management of the financial market. The loans and other greater financial operations which they used to claim as their own are now partly in the hands of the financial societies which differ from the credit establishments in the receiving of money deposits; the discounting of bills is but a secondary part of their functions.

3. The discounting banks are organized on the three signature principle and work in connection with the Banque de France. The majority of tradesmen use them and they in their turn apply to the banque where they get their bills discounted. They are of varied importance. Their number, which used to be very great in the provinces, tends to decrease owing to the constant development of the credit establishments.

There are three great establishments of that kind in France, viz.: the Crédit Lyonnais, the Société Générale and the Comptoir National d' Escompte de Paris, which all date from the middle of the 19th century. They occupy an intermediate position between the English joint-stock banks and the greater German societies. The credit establishments appeal to the public for funds, which they keep as deposits, they have created among a large part of the population the habit of having their money deposited in banks, and the parallel habit for bankers of relying for their operations upon the public's deposits as much as, if not more than, upon their own capitals. The credit establishments, like the joint-stock banks, use the greater part of their deposits for discounting purposes, they also devote a certain amount of them to investments and even to loans, although their extreme parsimony in granting the latter somewhat justifies the saying that in France "the credit establishments give no credit." At all events they never subscribe to an issue of commercial or industrial shares except in a very cautious manner and they are no more anxious to make issues of capital themselves than to invest in the ventures of others.

To complete the description of the organs of credit in France we have still to mention: (1) the popular and coöperative banks, as yet but little developed; (2) the land and estate banks (*banques foncières*), the operations of which are carried on in connection with those of the Crédit Foncier; (3) the postal transactions; (4) the savings banks; (5) the land credit establishments, recently created, whose action is still uncertain; (6) the *magasins généraux* where goods can be warranted; and last but not least the colonial banks, which are constituted under special laws and have a half-official existence. The two more important ones are the Banque de l' Algérie and the Banque de l'Indo-Chine.

The French banks are but scantily represented outside of France; there are only a few branches of the credit establishments in England, Belgium, Switzerland, Spain, and in Constantinople. Inversely each year sees the establishment in Paris of new branches of the foreign banks, a consequence of the plenty of capital which has made the French maket in our time the money-lender to the whole world.

It is impossible to give an estimate of the banking operations carried on in France. By the side of the joint-stock-companies whose statistics are made known to the public there exists a large number of private firms whose joint capital certainly exceeds that of the said companies and whose balance-sheets, statistics and other results remain unknown. There is, it is true, a clearing-house (*chambre de compensation*) in Paris, but it is only composed of a dozen members (they were 12 including the representative of the Banque de France, until April 1906, when their number was raised to 13), and the amount of business settled there is far from representing even the totality of operations transacted in Paris alone. We can, however, subjoin the following statistics, while warning the reader that under the conditions of secrecy prevalent in French private banking the returns are given below the full total. They are taken from the tables of the "Chambre de Compensation" from August 1905 to July 1906.

August	1,307,980,105.34 f.
September	1,341,554,109.98
October	1,603,870,536.92
November	1,683,615,955.76
December	1,614,230,136.30
January	1,903,637,453.28
February	1,601,753,339.76
March	1,529,573,040.80
April	2,047,658,568.36
May	2,096,259,438.48
June	1,820,128,657.44
July	2,115,685,423.50
	20,665,956,765.92 f.

The average per day during the same months was given as follows:

August	52,319,204.21 f.
September	51,598,619.61
October	61,687,328.34
November	67,344,638.23
December	64,569,205.45
January	73,216,825.12
February	66,739,722.49
March	56,650,853.36
April	85,319,107.01
May	80,625,363.01
June	72,805,146.29
July	84,627,416.94

Of the three great credit establishments of the state we have of course full statistics which we here append:

Cash, etc	292,700,000 f.
Loans and reports	915,000,000
Discounted bills	2,389,400,000
Stocks, shares, bonds	139,000,000
Check accounts	3,054,200,000
Creditor accounts	217,100,000
Undue bills	357,800,000

to which we may add a few more figures:

Capital	550,000,000 f.
Reserve funds	159,400,000
Net profit	45,904,052.40
Dividend	41,042,968.75

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19. France—The Colonies in 1907.—*Colonial Possessions in 1870.* On the establishment of the Republic after the defeat in 1870, French Colonial possessions were Algeria, and the Protectorship over 60,000,000 hectares, with 4,500,000 inhabitants. Of these about 3,500,000 were natives who submitted to French authority. In 1907 French trade with the colonies amounted to 560,000,000 francs, of which one-half was accredited to Algeria. The colonies have been converted into an empire across the sea—a greater France—which now comprises (besides Senegal, Guinea, Réunion, Mayotta and St. Mari in Africa; India, Cochin-China, Cambogia, in Asia; the Caledonia Islands and Tahiti, in Oceanica; Guiana. Martinique and Guadeloupe, in America; St. Pierre and Miquelon), Tonkin, Annam, Laos, Tunis, Madagascar, the Ivory Coast, Dahomey, Kongo, the coast of Somalis, the Comoro Islands, etc., 720,344,400 hectares in area (against 52,860,000 for continental France); nearly 45,000,000 inhabitants, of which [illegible]00,000 are Europeans, not counting Algeria and Tunisis. The commerce exceeds 1,500,000,000 francs. The report of the minister for the colonies shows an increase from 13,000,000 to 110,000,000 francs, and the reports from all the Colonies bring the amount up to 200,000,000 francs.

These figures suffice to show how France has reorganized the colonial domain that was lost from 1713 to 1763, and in 1815. These possessions are steadily and rapidly increasing. The French colonies are of sufficient importance to merit consideration.

ALGERIA.

France conquered Algeria in 1830, but the conquest took 17 years. It is no longer one colony, but a group of three provinces, governed like the metropolis. Algiers has 90,000 inhabitants; Oran, 90,000; Constantine, 52,000; Bone, 35,000; Philippeville, 20,000. The country consists of three sections: Tell, on a fertile region which includes the cities on the coast, and Kabylie, mountainous and fertile; the high plateaux; and the Desert of Sahara. It is ruled by a Governor-General, prefects, and army officers. The area of Algeria is 670,000 square kilometres. The climate is balmy, and some 12,000 strangers pass the winter season under its blue skies. In the region far from the coast the changes of temperature are more sudden. The population is 4,700,000, of which 700,000 are Europeans. It is the most important of the French colonies. Some 1,900 ships stop at Algiers. Its foreign commerce in 1906 amounted to 66,000,000 francs, against 55,000,000 in 1905. The importations from France average from 350,000,000 to 389,000,000 francs; and its exports amount to 278,500,000 frances. Railroads are to be extended 650 kilometres. The receipts, which amounted to 23,000,000 francs in 1896, have increased to 39,000,000 in 1906. In the departments of Constantine and Alger there are the fewest Europeans. It is well watered. Early fruits and vegetables and grain (hardy wheat and barley) are cultivated. It is rich in cork-trees, forests of oak, iron mines, phosphates of Tebessa, coral, and Spanish grass. In the department of Oran there are many settlers, especially Spaniards. Grapes and wheat are the chief products. The land is watered by the Chelif, the longest river in Algeria. The plateaux serve for breeding sheep. The towns are connected with each other by railroad, and with Marseilles by lines of steamships; also with le Sud, Oranais, Cette and Morocco. In 1847 the celebrated Arab chief, Abd el Kader, instigated the people of Morocco to revolt, but was defeated in the battle of Isly. The security and the development of Algeria require the French to take a prominent part in the affairs of Morocco; a country given over to anarchy, and whose tribes constantly trouble the frontiers.

Sahara borders Algeria. It is arid, but encloses great oasis, which have been made fertile by means of artesian wells. The nomads (Touaregs) have been forced to respect the caravans. The government of Algeria is a heavy task for France, which has become one of the greatest Moslem powers of the world.

TUNIS.

Tunis has been under the protection of France since 1881. In 25 years, by establishing ports, building railroads and roads, and by tilling the soil, this country has been transformed.

It is ruled by a Resident General assisted by delegations of financiers, and by an Advisory Council. It has an area of 13,500,000 hectares, of which 6,000,000 are under cultivation. Its climate is ideal. The land, being better watered than Algeria, is more fertile. The valley of Medjerda is the wheat land. The country is covered with olive trees and vines. The forests of Kroumrie, and fishing along the coast and in the lakes are sources of income. Its population of 1,800,000 is composed of 30,000 French, 25,000 Portuguese, 12,000 Anglo-Maltese, 80,000 Italians, and 4,000 of other nationalities. Of the 637,000 hectares under cultivation, 577,000 belong to the French, who have constructed 1,000 kilometres of railroad and 3,000 of roads. Steamers make the trip between Marseilles and Tunis in 35 hours.

The chief products are grain, wine, olives, oil, hides, oranges, dates, cork, Spanish grass and wool. Importations have increased 170,000,000 francs and exports even more. Its trade with France is 70,000,000 francs. Its report gives 40,000,000.

Tunis is a beautiful city of 250,000 inhabitants, including the outskirts. It is the residence of the Bey, and of the French minister. Its port is Goulette. It is connected by railroad with Bizerte, where a French naval station is established.

The other cities are: Sousse, Sfax, Gabes, and the holy city, Kairouan. The railroad (1,200 kilometres) connects Tunis with the frontier of Morocco by way of Constantine, Algiers and Oran. 1,500,000 tons of merchandise and 150,000 travellers enter its ports every year.

FRENCH WESTERN AFRICA.

Since 1626 France has possessed large territories in Africa, called the Colony of Senegal and Dependencies.

The vast possessions of France in Western Africa, since June 1895, have been under one central government the organization of which united (in 1904) a group of five colonies, each one ruled by a Lieutenant Governor who is under the Governor-General. They are (1) Senegal; (2) French Guinea; (3) The Ivory Coast; (4) Dahomey; (5) Upper Senegal and Niger (the colony of Soudan). To these must be added the political division of Mauritanie, ruled by a Government agent. Titdjilka is its chief city. The Governor-General is assisted by a council appointed by the Government. The seat of this liberal government is at Dakar. The general trade report is 42,000,000 francs. This pays the government expenses and the duties. Dakar has many large structures of public interest, built on made foundations. Its area is 5,600,000 square kilometres. The water-courses are dammed, and on the Ivory Coast and in Dahomey wharves have been built. The Senegal and the Niger are the two great rivers of the country. The climate is very variable and the heat, which reaches 45°, is exceedingly trying. It is inhabited by musulmans and many other races.

Senegal.—Senegal is under two different administrations: (1) that of the coast, where the inhabitants are French; (2) the Protectorate country. The principal city is St. Louis (24,000 inhabitants). The other important cities are Roufisque (20,000 inhabitants), the emporium for peanuts and the centre of business; Dakar (24,000 inhabitants), the centre of navigation; and Gorée, on the island of the same name. The total population is 1,200,000 inhabitants.

Trade has increased from 45,000,000 in 1894, to 100,000,000 francs in 1906. (60,000,000 imports, and 40,000,000 exports.) Of this amount the French importations do not reach 30,000,000. The products exported are chiefly peanuts, gums, india-rubber, almonds; also birds, feathers, and elephants' tusks. The railroad connects Dakar with the Niger.

Senegambia-Niger.—This government extends to Lake Tchad and to Tombouctou. The budget gives a little more than 6,000,000 francs. The principal cities are Kayes (15,000 inhabitants), 911 kilometres from St. Louis—the terminal of the railroad between Senegal and the Niger; Segou, the cotton city and the centre of the india rubber trade; Zinder 30,000 inhabitants. The capital will soon be transferred to Bammako. The cultivation of cotton is developing rapidly in this region.

Mauritanie.—This is a country for breeding cattle and sheep. Salt meats are exported. This territory was annexed to French Western Africa.

Guinea.—Its principal city is Konakry on Tourbo island, opposite the Loos islands, which were recently ceded to France by England. Business houses and stores are numerous. In the last 10 years commerce has increased from 10,000,000 to 35,000,000 francs. (18,000,000 exports; 17,000,000 imports.) The principal products are india rubber (which has increased from 3,000,000 to 12,000,000 francs); palmettos, peanuts, sesamun, hides and bananas.

The Ivory Coast.—The chief town is Bingerville, adjoining the new city of Abidjan, from which the railroad will soon be built as far as Kong (280 kilometres distant). The trade amounts to 10,000,000 francs imports, and 8,000,000 exports. From America is received lard and tobacco. The exports are oil, almonds, india rubber, mahogany and kola nuts. Coffee and cocoa are being cultivated. This colony, whose most important town was formerly Grand Bassam, dates from 1843.

Dahomey.—The seat of the government is at Porto-Novo. The railroad (built for 205 kilometres) will go as far as the Niger. Porto-Novo (76,000 inhabitants) is superseded by Cotonou, which is connected with it by an iron wharf 208 metres long. The products are the same as in the preceding colony. The imports amount to 12,000,000, and the exports to 10,000,000 francs. Great attention is being given to the cultivation of cotton. The natives live on Indian corn, manioc millet and rice.

CONGO.

The origin of the colony of French Congo dates back to 1843; it became a colony in 1881. The present state of Congo, with its dependences, comprises (1) the colony of Gabon; (2) the Middle Congo; (3) Oubanghi-Chari; (4) Tchad. It is governed by a Commissary-General who resides at Brazzaville, and also by a Lieutenant-Governor at Gabon. The general-domain was organized in 1899. Its products are the same as those of the preceding colonies. Trade amounts to 7,000,000 francs imports, and 10,000,000 francs exports.

THE SOMALIS COAST.

This territory was bought in 1858 and in 1862, and settled in 1883. The seat of the government was transferred to Djibouti, and in 1896 the colony took the name of the French Coast of Somalis. It is connected by cable with Perim and large steamers touch here. It is a protectorate. The principal exports are ivory, gold, hides and coffee, amounting to a trade of 11,000,000 francs exports and 8,000,000 francs imports.

The importance of Djibouti is the result of its railroad connection with Addis Abbaba, the capital of Ethiopia. It is the point of departure for caravans, and the products of the country. Djibouti has a population of 600 Europeans and 6,000 natives. Cheik-Said is a French possession, notwithstanding that the Turks have unlawfully placed a garrison there. The island of Perim has the advantage of being supplied with soft water. Its situation commands the entrance to the Red Sea.

MADAGASCAR.

The colonization of Madagascar by the French began in 1642, under Louis XIV. Napoleon III. made a treaty with the queen in 1862. The Hovas having neglected it, the French took the capital, 30 Sept. 1895. The island was declared a colony shortly after the insurrection of 1896-98. It is 2,500 leagues from France, and 150 leagues from Réunion. Its area is 580,000 square kilometres. Although it is as large as France, Belgium and Holland together, it has only 2,500,000 inhabitants, including 850,000 Hovas in the interior, 500,000 Betsilleos in the South, and the Sakalaves in the East. The coast is unhealthy, but thus far the high plateaux have been salubrious.

The annual report amounts to 24,000,000 francs. In 1895 the imports were 14,000,000 and the exports 4,000,000 francs. These figures have increased to 38,500,000 francs and more than 28,000,000, making a total of 65,000,000. The principal exports are india rubber, raflia, cattle, vanilla, cloves, gum, cocoa and coffee. There are important cotton plantations in the west. The native industries consist of the making of rope-bands, lace, and straw hats, and there are many other enterprises. The railroad from Tananarive to Tamatave is in course of construction. Its terminus is connected with the sea by the means of the Pagalanes canal. The principal cities are Tananarive (50,000 inhabitants), Tamatave, the chief port on the east coast, and Majunga on the west coast.

The magnificent roadstead of Diego-Suarez serves as a base for naval operations. The colonization has been directed by General Gallieni, who is an organizer, and ruler, as well as an energetic military leader.

THE COMORES.

Mayotte.—The archipelago of the Comores consists of four islands. Mayotte, the seat of government, has been a colony since 1843; Anjouan has been under our protection since 1886, and the Large Comore and Moheli since 1887. All these belong to Madagascar. The area is 2,124 kilometres. The population consists of 50,000 Musalmens. Mayotte was devastated by a cyclone in 1899. Anjouan has prospered thanks to its vanilla, coffee, cocoa and cotton. Its trade amounts to 1,800,000 francs imports, and 2,400,000 francs exports.

GUADELOUPE.

Guadeloupe has been a French colony since 1674, and suffered vicissitudes in French continental wars. It consists of two islands; Basse Terre, and Grande Terre, separated from it by a short arm of the sea; Basse Terre has but one port (of the same name); Grande Terre has five ports, the principal one of which is Pointe à Pitre. Its trade amounts to 17,000,000 francs imports, and as much in exports, which consist in sugar, rum, coffee, cocoa, vanilla and logwood. Population 140,000. Its dependencies are the islands of Désirade, Petite Terre, Sainte, Marie Galante, two-thirds of St. Martin, and St. Bartholomew.

MARTINIQUE.

Martinique has been a French colony since 1664. The island is 70 kilometres long and 31 wide. It is volcanic, the same as Guadeloupe, and the eruption of Mt. Pelée in 1902 destroyed the city of St. Pierre which had 25,000 inhabitants. The population of Fort de France, the principal city, is 15,000. Its trade amounts to 20,400,000 francs imports, and 15,000,000 exports—about the same as Guadeloupe. The colony has recovered from the disaster, and is resuming its business enterprises.

GUYANA.

Guyana is one of the oldest French colonies It lies between Dutch Guiana and Brazil. It dates from 1674 and it only has 33,000 inhabitants, 12,600 of whom are in Cayenne, the principal city. Notwithstanding that gold has been exported since 1855, ebony forms its chief export. The exports are valued at 13,000,000; the imports amount to 10,500,000 francs. Besides its gold deposits, the country has magnificent forests. It has been neglected because criminals have been transported there. However, it possesses the same elements of growth as its neighbors, British Guiana and Dutch Guiana.

ST. PIERRE AND MIQUELON.

The first French settlements were made there in 1604. These islands were taken from France in 1713 (Treaty of Utrecht) restored in 1763 (Treaty of Paris), and ruined during the war of American Independence. The English banished the inhabitants in 1778. The treaty of 1783 gave France jurisdiction over them. They have only 6,500 inhabitants. The imports amount to 8,000,000, and exports to 10,000,000 francs, and consist of codfish, oil, lobsters and salmon. The islands are the chief fishing station for French vessels on the shores of the Atlantic.

RÉUNION.

This colony dates from 1671. It used to be called Bourbon. Its climate is excellent. It is 71 kilometres long, 51 wide, and has an area of 2,600 square kilometres. Its hot springs of Salazie, Cilaos and Massate are celebrated. In the mountains the temperature is sometimes below zero. The summers are very warm. The island was ravaged by cyclones in 1904 and 1905. There are two ports: St. Denis, the principal one (38,000 inhabitants), and St. Pierre (27,000 inhabitants). Its report is 4,500,000. Imports, 22,000,000 and exports, 20,000,000 francs, consisting of sugar, coffee, vanilla, rum, tapioca and tobacco. The spice trees of the Sonde Islands were introduced there in 1770 by the commissary, Poivre. Its nearness to Madagascar also gives it an outlet for trade. It is thoroughly French. The French of Maurice—its neighbor which has become English—still speak their own language.

NEW CALEDONIA AND NEW HEBRIDES.

France took possession of New Caledonia in 1853. Its dependencies are the Isles of Pines, Loyalty and Huon; but the archipelago of New Hebrides—which is 30 hours' distant from it by steamer, and four days from Sydney—was (February 1907) the subject of a convention which established joint rule with England. The area of New Caledonia is 2,100,000 hectares, of which one-half is mining land, 500,000 hectares of pasturage and lands under cultivation; the remainder is forest. The annual report amounts to 4,000,000 francs. The climate is excellent and favorable for colonization. In August, which is its coolest season, the temperature is as low as 13°. The population is 13,000 colonists, more than 10,000 convicts, and 30,000 natives. No convicts have been sent there since the beginning of this century. The colony is connected with Brisbane, Australia, by a line of steamers and a cable. Its trade amounts to 21,800,000 francs, of which 10,800,000 are imports, and 11,000,000 exports. The latter are the finest quality of coffee, valuable woods, and especially minerals—nickel 130,000 tons; chrome, 45,000; cobalt, 8,000. Blast furnaces are about to be constructed, and the coal and copper mines are being worked.

This colony lies on the route to Australia, San Francisco and Panama, on the one side, and on the other it lies on the route from Panama to Indo-China, and China-Seas. Its vast harbor of Noumea must consequently become the chief port of the Pacific.

New Hebrides.—The New Hebrides, in the same archipelago, comprises 70 islands, whose area is 1,600,000 hectares. The French possess 950,000, and the English 235,000. Agriculture and commerce are in the hands of 400 French colonists, against 100 English—70 of these are only Wesleyan missionaries. These very fertile islands are the granary of the Caledonia islands, a mining country. They are inhabited by 70,000 Canaques and furnish laborers for the same archipelago. It is contended that France has much more right to these islands than England; but Australia wanted them bestowed upon her and the convention of February 1907 established a French-English protectorate over them. It is thought that this *modus vivendi* is only temporary. The situation of the archipelago will assume great importance when the Panama canal is opened.

OCEANICA.

Tahiti.—The colony of Tahiti comprises the archipelago of the Society Isles, the Marquises, the Tuamatou, the Gambiers, the Tubuai, and, in the centre of the Pacific the small island of Clipperton, the advance sentinal of Panama. It is 1,200 leagues from the main land, and has belonged to France since 1842.

Tahiti's climate is charming, and the people are very kindly. It has 30,000 inhabitants. Trade amounts to 4,000,000 francs imports, of which 1,700,000 come from the United States, 665,000 from New Zealand, and 600,000 from France. The exports amount to 4,700,000 francs, of which 80,000 are sent to France and 200,000 to foreign ports. The exports are copra, vanilla, cotton, cocoanuts, oranges, and mother-of-pearl. The colony has no maritime or postal connection with the metropolis. The transportation of mail and passengers, and of most all the merchandise is done by the Union Steamship Company, which connects Tahiti with New Zealand; and by the Ocean Steamship Company, which connects it with San Francisco. These two companies are subsidized by the colony and by France. It is thought that the postal service will be established when the Panama canal is opened.

INDO-CHINA.

Indo-China is the most important of the French colonies. It is 14,000 kilometres distant from France. It is divided into five parts: Cochin-China, settled in 1858; the Protectorate of Cambodia, in 1853; Annam, in 1874; Tonkin, in 1885; Laos (direct possession), in 1893; and Quang Tcheou (off the coast of China), in 1898. The area is 712,000 square kilometres, and there is a population of 23,000,000 of very diverse nationalities—Annamites (three-quarters of the inhabitants); Cambodians and Chinese; Laotians, 132,000 Kiams and 800,000 Mais or Khas (savage tribes). 18,000 of the inhabitants are French. The annular expenditures are 105,000,000 francs, 78,000,000 of which are for the general budget and 35,000,000 for the six countries. Its foreign commerce, which was 205,000,000 francs in 1897, has been 400,000,000 francs since 1904. Nearly 2,000 steamers of 2,250,000 tons and 3,300 of 50,000 tons frequent its ports. American steamers come here for rice. A network of railroads, of more than 2,000 kilometres, is being built—valued at 266,000,000 francs. The public works and the domestic affairs of the colony are progressing rapidly. The principal exports are rice, tea and coal. This colony has not been forced into union, it was naturally united.

Cochin-China.—The area of Cochin-China is 57,600 square kilometres; population 3,000,000, of which 5,000 are French. Saigon is 40 miles from the sea, and one of the most beautiful cities in the far East. Decortications are prepared for three times as much rice as they have. The rice export in 1867 was 14,000 tons; it is now a million. Other exports are pepper, 3,000 tons; cotton, sugar and copra. Cho-len on the outskirts of Saigon, is the most important centre of native and Chinese trade. Tonkin has an area of 174,560 kilometres, and 10,000,000 inhabitants, 4,000 of whom are French. The climate is more supportable than Cochin-China. The chief cities are: Hanoi, 150,000 inhabitants; Haiphong, 15,000, and Namdinh—the commercial, artistic and literary centre—50,000.

Annam-Hué, the capital of the kingdom, and the seat of the French Legation, has 40,000 inhabitants. The area of Annam is 133,760 square kilometres; population 6,000,000. The vicinity of the sea renders the climate very agreeable to Europeans. The chief cities, after Hué, are Tourane, with its mines of coal, copper and gold, and its tea plantations; and Fai-fo, an emporium for native trade, which exports 2,000,000 francs worth of cinnamon to China.

Cambodia.—The area of this colony is 200,000 square kilometres; population 1,800,000, of which 600 are Europeans. The climate is very warm. The products are rice, cotton, silk, pepper, gums, cardamon, sugar, tobacco and the fish caught and salted by the 30,000 fishermen of the great lakes. Cambogia has only one small port —Kampot. The capital is Phrompenh, 60,000 inhabitants. It is a great river port at which steamers stop all the year round.

Laos.—The area of Laos is 300,000 square kilometres; population 1,000,000, of which 500,000 are Thais; 400,000 Khas; 5,000 Khmers; 2,000 Annamites; 300 Chinese; and 150 Europeans. The two capitals are Luang-prabang, 25,000 inhabitants, situated in the northern part; and Vien-charh in the centre. Its products are cardamon, benzoin, india rubber, gum-lac, tin. Its gold, iron, salt, and gem mines are to be worked.

Kouang Cheou Wan.—Its area is 1,000 kilometres; population 160,000. The chief town and most important port is Pointe Nivet. Its products are the same as in the southern part of China. It is a free port frequented by 210 ships. The total commerce amounts to 8,600,000 francs. This territory will be connected with Tonkin by railroad. The colony is a base for extensive business transactions, and its commercial activity will extend to the countries which consume rice —those bordering the China seas and the Pacific.

INDIA.

French settlements in India, the chief cities of which are Pondichery, Chandernagore, Yanaon, Karikal and Mahé, are all that remain to us of the immense empire of Dupleix, which has become the Empire of British India. Area 51,000 hectares; population 175,000. The trade amounts to 9,300,000 francs imports, and 28,000,000 exports, consisting of blue-cotton cloth, peanuts, coffee, saffron, tamarins and salt fish. The cities are connected with the railroads of India, and a line of French steamers runs to Pondichery. The population consists of 125,000 natives and 1,000 creoles.

CANADA.

From the fact that French emigration is only 20,000 per year, we must not conclude that the French do not colonize. They know how to please the natives, and the survival of the French spirit in the colonies we have lost is proved by the fact that 2,000,000 Canadians still speak the French language.

LOUISIANA.

There are 1,500,000 French in Louisiana in the United States, and 500,000 in the Antilles, no longer French possessions; as Haiti, half of which France once owned; and there are also many French emigrants in the republics of South America. The following tables show (1) the value of the commerce of the French Colonies; (2) their respective value in economics; and (3) their size, population, expenditures, and commerce (both imports and exports).

TABLE OF THE TRADE OF THE FRENCH COLONIES (1905).

NAME	Imports, francs	Exports; francs	Total, francs	Total trade with France, francs	Total trade with French colonies, francs	Total foreign trade, francs
Algeria	....	....	....	....	....	....
Tunisi	....	....	....	....	....	....
Western Africa	96,867,458	56,207,918	153,075,371	68,254,180	4,148,917	80,672,274
Congo	10,379,146	13,932,745	24,311,891	9,188,059	137,201	14,986.631
Réunion	18,184,824	9,708,252	27,893.076	19,070,181	2,049,479	6.778,466
Madagascar	31,198,410	22,850,592	54,049,002	42,298,311	1,679,980	10,070,711
Somalis Coast	771,926	3,096,661	3,868 587	2,891,471	447,748	529,368
Mayotte and Dependencies	11,929,941	19,219,004	30,148,945	193,146	288,380	26,667,418
French Settlements in India	6,356,207	27,185,997	33,542,204	14,033,365	2,311,724	17,297,115
Indo-China	254,560,279	168,757,653	423,317,932	138,697,020	6,010,578	278,610,334
St. Pierre and Miguelon	5,439,521	7,119,311	12,558,832	8,690,483	272,598	3,595,751
Guadeloupe	13,438,419	15,637,471	29,075,890	21,936,229	698,497	6,446,164
Martinique	14,759,172	18,069,422	32.828,594	23,785,955	956,028	8,086.611
Guiana	11,439,375	9,939,491	21,378,866	16,446,556	529,606	4.402.704
New Caledonia	10,726,657	11,070,378	21,707,035	8,582,687	193,518	13,021,030
Oceanica	3,028,161	3,062,569	6,090,730	1,023,250	146,381	4,920,829
Total	489,079,491	384,857,464	873,934,955	378,091,113	19,765,441	476,075,201

TABLE OF THE GENERAL SITUATION OF FRENCH COLONIES.

COLONIES	Area in kilometres	Inhabitants		Report for 1905, francs c.	Commerce	
		Natives	Europeans		Exports, francs	Imports, francs
Algeria	670,000	4,000,000	700,000	39,000,000	300,000,000	400,000,000
Tunisi	135,000	1,650,000	150,000	40,000,000	80,000,000	70,000,000
WESTERN AFRICA—						
Senegal	....	....	290	5,710,916.50	40,630,012	51,662,996
Senegambia-Niger	....	....	256	12,809,500.50	40,630,012	51,662,996
Guinea	2,525,000	9,000,000	4,000	5,100,000.50	14,090,743	17,942,974
Ivory Coast	....	....	176	3,000,000.50	7,613,460	9,078,131
Dahomey	....	....	190	5,306,218.14	9,540,066	11,264,258
Congo	1,800,000	8,000,000	580	5,540,006.86	9,938,242	6,978,077
Somalis Coast	36,000	200,000	400	1,175,000.86	10,450,900	7,530,221
Madagascar	580,000	3,000,000	16,200	23,805,000.86	16,271,010	32,898,554
Mayotte	356	9,000	1,018	238,865.86	2,381,888	1,715,272
Great Comore	1,102	45,000	4	172,100.86		
Anjouan	378	15,000	5	113,741.25		
Mohsli	231	9,000	2	28,700.25		
Guadeloupe	1,780	183,000	6,450	5,628,600.90	16,658,297	16,408,801
Martinique	987	200,000	5,400	4,962,128.90	15,104,073	20,389,568
Guiana	80,000	34,000	3,180	2,942,108.34	12,830,391	10,468,081
St. Pierre and Miquelon	242	7,000	6,545	799,246.30	9,552,744	8,306,117
Reunion	2,600	174,000	406	5,279,000.30	19,191,900	21,508,588
Caledonian Isles	20,078	20,000	12,196	3,769,910.30	8,963,895	13,671,998
Oceanica	4,002	28,000	3,061	1,823,745.30	4,678,052	3,907,996
Indo-China	2,200,000	23,500,500	18,246	96,995,756.44	120,448,505	204,253,872
The Indies	588	273,000	78	2,385,328.82	28,059,017	9,319,596
Total	7,203,344	44,697,000	78,683 Fig. incompl.	187,585,870.75	345,903,195	447,304,420

RECAPITULATION OF THE ECONOMIC VALUES OF EACH COLONY (CAPITAL INVOLVED).

	Francs.
Réunion	100 000.000
Guadeloupe	138 000 000
Martinique	100 000 000
Guiana	80.885 000
The Indies	63.241 000
New Caledonia	114.464.000
French Settlements in Oceanica	11.822.000
Saint-Pierre and Miguelon	21.244 000
Indo-China	544.709.000
Western Africa	223.643.000
Madagascar	190.044.000
Comores	18.483.000
French Coast of Somalis	64.300 000
Congo (Capital of the Societies)	60.490 000
Total	1,728,325.000

Thus the increase in value resulting from industrial and commercial enterprises and the investment of capital amounted, in 1907, to nearly 2,000,000,000 francs.

RESUMÉ.

From the above data it can be seen that French domain is of vast extent and is rapidly increasing in value. Its internal affairs, and its business enterprises show a steadily increasing prosperity, and the future outlook is full of hope and involves great responsibility.

M. CHARLES LEMIRE,
Conseiller du Commerce Exterieur.

France, Isle of. See Mauritius.

Francesca da Rimini. See Da Rimini, Francesca.

Francesco di Paula, frän-chĕs'kō dē pō'lä, or **Saint Francis of Paola,** Italian monk: b. Paula or Paola, Calabria, 1416; d. Plessis-les-Tours 2 April 1507. At the age of 13 he was the inmate of a Franciscan convent; and at 19 retired to a cave where he inflicted on himself every species of self-mortification. The fame of his piety having attracted to his cell several emulators of his austere life, he obtained permission to erect a convent, and the new community received from Pope Sixtus IV. the title of the Hermits of St. Francis of Assisi; but the title was changed by Alexander VI. to Minim-Hermits of St. Francis of Paola. The founder established numerous communities in Italy, Sicily, France, Spain, and Germany, but the Minims were never settled in Great Britain or Ireland. To the usual conventual vows, Francesco added one of the most rigorous abstinence — flesh, eggs, cheese, and milk being strictly forbidden the entire year, except in illness. In Spain they were called the Brothers of Victory, in commemoration of the deliverance of Malaga from the Moors. Twelve years after his death he was canonized by Leo X., and the Roman Catholic Church celebrates his festival on 2 April.

Franchetti, frän-chĕt'tē, Baron **Alberto,** Italian composer: b. Turin 1860. He was a pupil in Coccon and Magi, studied at Dresden and Munich, and in 1888 produced his most successful opera ‹Asraele.›

Fran'chise, in law, a right belonging to a subject of exercising a branch of the sovereign or government prerogative, either in virtue of a grant conferring such right, or by prescription, which always presupposes such a grant. The corporate franchise, that is, the right of being incorporated, and of holding fairs, ferries, etc., are among the most important franchises, which are, however, almost infinite. In politics it is the right of voting upon proposed legislative measures, where such measures are accepted or rejected by the people generally; or for representatives to a legislative assembly (the parliamentary franchise) or to a municipal body.

Francia, frän'chä, easel name of Francesco di Marco di Giacomo Raibolini, Italian painter: b. Bologna 1456; d. there 5 Jan. 1517. He assumed his name of Francia from that of the goldsmith under whom he began his art studies. He was a pupil in painting of the Ferrarese, Lorenzo Costa, and shows the influence of his master's style. He painted portraits and history, his greatest work being the Bentivoglis altarpiece, in the Church of San Giacomo Maggiore, Bologna.

Francia, José Gaspar Tomas Rodriguez da, hō-sā' gäs'pär tō'mäs rō-drē'gĕs frän'sē-ä, Paraguayan dictator: b. Asunçion 1756; d. there 20 Sept. 1840. He was sent to the University of Cordova, with a view to entering the Church; but his plans underwent a change, and on his return to his native town with the degree of doctor of laws, he began his public career as a barrister. His high reputation for learning, but still more for honesty and independence, procured him an extensive practice; and he devoted himself to legal pursuits for 30 years. In 1811, when Paraguay threw off the Spanish yoke, he became secretary of the junta appointed by congress. In 1814 he was appointed dictator for three years, and in 1817 he was continued in authority for life. No sooner had he reached the goal for which he had been striving than he began to display the utmost tyranny in his administration. He was kindly disposed toward foreigners, till they excited his jealousy by the culture of Paraguay tea, of which he made a state monopoly. After everything had been placed completely at his beck he seemed, in 1824, disposed to return to milder courses, but a new attack of his constitutional malady led him again to a renewal of his tyrannical proceedings; but as Paraguay had improved under his government, and the inhabitants had become reconciled to his tyranny, he was able to continue his system till his death.

Franciabigio, frän-chä-bē'jō, (the easel name of Francesco di Cristofano Bigi), Italian painter: b. Florence 1482; d. there 24 Jan. 1525. He was a pupil of Albertinelli, where he met and made a friend of Andrea del Sarto. The two artists painted in collaboration the frescoes in the Santa Annunziata Church at Florence. In these paintings the influence of del Sarto is very apparent, as well as in the ‹Last Supper,› which Franciabigio painted in the refectory of San Giovanni, and the oil painting at Dresden, ‹David and Bathsheba.› He has left many excellent portraits, one of which is in the Berlin Museum.

Fran'cillon, Robert Edward, English novelist: b. Gloucester, England, 25 March 1841. He was educated at Trinity Hall, Cambridge. He was admitted to the bar in 1864 and was on the staff of the London *Globe* 1872-94. His novels are: ‹Earl's Dene›; ‹Pearl and Emerald› (1872); ‹Olympia›; ‹Strange Waters›; ‹Zelda's Fortune›; ‹A Real Queen›; ‹Queen Cophetua› (1880); ‹Under Slieve-Ban› (1881); ‹King or Knave› (1888); ‹A Dog and his Shadow›; ‹Jack Doyle's Daughter›; ‹Ropes of Sand›; ‹Gods and Heroes›; etc.

Francis I., king of France: b. Cognac, France, 12 Sept. 1494; d. Rambouillet 31 March 1547. He succeeded to the throne in 1515, on the death of Louis XII., who died without male issue. As grandson of Valentino of Milan, he put himself at the head of an army to assert his right over the Milanese. The Swiss, who opposed him in his entry into the duchy, were defeated at Marignano (or Melegnano), and Milan fell immediately after this victory. After a short war with England, the famous interview between Henry VIII. and Francis took place, in 1520, in Flanders, which, from the magnificence displayed on the occasion, was called The Field of the Cloth of Gold (q. v.). In the same year, Charles V. of Spain having inherited the empire after the death of Maximilian, Francis laid claim to the imperial dignity and declared war against his rival. In this struggle, however, he met with nothing but reverses. After the defeat of Marshal Lautrec at Bicoca, in 1522, the retreat of Bonnivet, and Bayard's death, Francis was himself, in 1525, beaten at Pavia, and taken prisoner. The fight had been a fierce one, and the king wrote to his mother, «All is lost, except honor.» Led captive into

Spain, he recovered his liberty only at the cost of an onerous treaty, signed at Madrid in 1526; but which Francis subsequently declared null and void. He immediately recommenced war in Italy, met with fresh defeats, and concluded a second treaty at Cambrai in 1529. He once more invaded Italy, in 1536, and, after various successes, consented to a definite arrangement at Crespi, in 1544, by which the French were excluded from Italy, though Milan was given to the Duke of Orleans, the second son of Francis. Francis was a friend to arts and literature, which flourished during his reign; and he was called the «Father of Letters.» Justice, also, began to be better administered in his reign. He founded the Royal College of France, the Royal Library, and built several palaces. He was succeeded by his son, Henry II.

Francis II., king of France, son of Henry II. and Catharine of Medici: b. Fontainebleau 19 Jan. 1544; d. Orleans 5 Dec. 1560. He ascended the throne on the death of his father, 10 July 1559. The year previous he had married Mary Stuart, only child of James V., king of Scotland. During his short reign of 17 months were sown the seeds of those evils which afterward desolated France. The uncles of his wife, Francis, Duke of Guise, and the Cardinal of Lorraine, held the reins of government. The latter stood at the head of the clergy, and had charge of the finances. The former had the direction of military affairs; and both used their power solely as a means of gratifying their pride and avarice. Antony of Bourbon, king of Navarre, and his brother Louis, Prince of Condé, provoked that two strangers should govern the kingdom while the princes of the blood were removed from the administration, united with the Calvinists to overthrow the power of the Guises, the protectors of the Catholics. Ambition was the cause of the quarrel, religion the pretext, and the conspiracy of Amboise formed among the French nobility, especially the Calvinists, with the object of removing the king from the influence of the Guises, the first symptom of the civil war. The war broke out in March 1560. In December of the same year Francis died, leaving the kingdom loaded with debt, and a prey to all the miseries of civil war.

Francis I., emperor of Germany: b. 8 Dec. 1708; d. Innspruck 18 Aug. 1765. He was the son of Leopold, Duke of Lorraine. He inherited this duchy from his father in 1729, and six years afterward exchanged it for that of Tuscany, which the death of the last of the Medicis had rendered vacant. In 1736 he married Maria Theresa, the daughter of the Emperor Charles VI. On the death of the latter, he disputed the imperial dignity with the elector of Bavaria, whom France supported, and who took the name of Charles VII.; he was, however, defeated, and Francis reigned peaceably for 20 years. He had 16 children, among whom were Joseph II., who succeeded him, and the unfortunate Marie Antoinette. See MARIA THERESA.

Francis II., emperor of Germany, and I. of Austria: b. Florence, Italy, 12 Feb. 1768; d. Vienna 2 March 1835. He succeeded his father, Leopold II., in 1792, as emperor of Germany, king of Bohemia, Hungary, etc. At the very commencement of his reign, he had to sustain a war against France, in which he was defeated, and was, in 1797, obliged to sign the treaty of Campo Formio, which deprived him of the Netherlands and Lombardy. Another war taking place with the same power, he was not more fortunate than in the first, and was beaten at Marengo, and lost, by the Treaty of Lunéville, in 1801, all his possessions on the Rhine. In a third campaign, undertaken in 1805, the French were victorious over his armies at Elchingen, Ulm, and Austerlitz; and the Treaty of Presburg still further diminished his territory. Renouncing now the title of emperor of Germany, he took that of Austria, under the name of Francis I. He tried again the fate of battles in 1809; but the defeats of Eckmühl and Wagram led to the Peace of Schönbrunn, to cement which more strongly his daughter Maria Louisa was, in 1810, given to Napoleon I. Notwithstanding this alliance, however, he, in 1813, joined the coalition against his son-in-law and contributed considerably to his overthrow. The treaties of 1815 put him again in possession of the greater portion of his territory, and he reigned peaceably till his death.

Francis I., king of the Two Sicilies, son of Ferdinand I.: b. Naples 19 Aug. 1777; d. there 8 Dec. 1830. Twice during the lifetime of his father he carried on the government of the kingdom under the name of viceroy; first in 1812, when a constitution was granted to Sicily; and afterward in 1820, during the troubles which broke out in Naples and Palermo. He mounted the throne in 1825, and died 1830, without having achieved anything remarkable. He was succeeded by Ferdinand II.

Francis II. (Francesco d'Assisi Maria Leopold), king of the Two Sicilies: b. Naples 31 Jan. 1836; d. 27 Dec. 1894. He succeeded his father, Ferdinand II., in 1859, and attempted to carry out the monarch's policy. His dominions were invaded by Garibaldi in 1860 and Gaeta, his last stronghold, fell in 1861. Subsequently the deposed ruler lived in France in retirement, occasionally organizing abortive expeditions against the Italian kingdom.

Francis Joseph, Charles, emperor of Austria: b. Vienna 30 Aug. 1830. He became emperor 2 Dec. 1848, and found the empire shaken by internal dissensions; and his first step was to promise a free and constitutional government to the country. The course of events, however, compelled him to close the national assembly, and to assume absolute power. He centralized the governments of his heterogeneous nationalities at Vienna, and, aided by Herr Von Brück, inaugurated a series of fiscal and commercial reforms favorable to the interests of the middle classes. In 1853-4, the emperor endeavored, though in vain, to induce the Czar Nicholas to abandon his ambitious designs against Turkey, and further excited that autocrat's displeasure by refusing to assist Russia against the western powers, whose rulers also felt aggrieved because he resolved to remain neutral and declined to throw the weight of his name into their scale. The unwillingness of Austria to make common cause with the western powers has been severely punished, for had she joined the alliance against Russia in 1854, in all probability Louis Napoleon would not have crossed the Alps and dictated the Peace of Villafranca. It is, therefore, more than probable that her reluctance to act against Russia in that war was the cause of her losing Lombardy three years later. At Solferino the emperor gave proof of bravery amounting almost to rashness. In April 1854 he married the Princess Elizabeth Amalie Eugenie, daughter of the Duke Maximilian Joseph, and cousin, on her mother's side, to the king of Bavaria. The plenipotentiaries of Austria, Prussia, and Denmark, assembled at Vienna to consider the terms of a peace, 26 July 1864, which was concluded 30 October. The convention of Gastein signed 14 Aug. 1865, transferring the government of Schleswig to Prussia, and that of Holstein to Austria, was a few days after confirmed by the emperor and the king of Prussia at Salzburg. The emperor issued an important manifesto to his people, 20 September, in which he expressed very conciliatory intentions toward the peoples of Hungary and Croatia. At the beginning of 1866, the armaments against Prussia commenced, and an imperial order was issued 6 May, placing the whole army on a war footing, and concentrating the army of the north on the frontiers of Bohemia. In 1867, the emperor put an end to the hostilities of Hungary by re-establishing the constitution of that country; and on 8 June, he was crowned at Budapest as king of Hungary, with extraordinary pomp. In December of the same year, a new constitution, one of the most liberal of continental Europe, framed by the Reichsrath, was approved by the emperor, and promulgated as the fundamental law of the empire. His only son, Rudolf, committed suicide in 1889, and the emperor's nephew, the Archduke Francis Ferdinand, is heir-presumptive. See AUSTRIA.

Francis, David Rowland, American politician: b. Richmond, Ky., 1 Oct. 1850. He was graduated from Washington University, St. Louis, 1870, entered business and in 1877 established the firm of of Francis Brothers, grain merchants, St. Louis. He was mayor of St. Louis 1885–9, governor of Missouri 1889–93, secretary of the interior under President Cleveland 1896–7, and became president of the Louisiana Purchase Centennial Exposition in 1901.

Francis, Joseph, American inventor: b. Boston, Mass., 12 March 1801; d. Cooperstown, N. Y., 10 May 1893. He was the inventor of a number of life-boats and life-cars which came into general use and by means of which 200 persons were saved when the British ship Ayrshire was wrecked on the New Jersey coast in 1850. It is estimated that in four years as many as 2,150 lives were saved.

Francis, M. E. See BLUNDELL, MRS. FRANCIS.

Francis, SIR **Philip,** British statesman: b. Dublin 22 Oct. 1740; d. London 23 Dec. 1818. He is the best accredited of the candidates for authorship of the 'Junius' letters. He entered the civil service, and was rapidly advanced, owing partly to his abilities and partly to personal influence curiously accordant with partialities shown in the 'Letters.' Suddenly raised to the lofty position of one of the resident India council appointed by Parliament to control those affairs, he went out to India; spent his time there in a furious contest for supremacy with Warren Hastings; was finally vanquished, but achieved a terrible revenge after his return to England, by inciting Hastings' impeachment and coaching Burke; entered Parliament, prepared many pamphlets and made many speeches of much ability and unfailing acrimony. The 'Letters'— savage assaults on the heads of the party in power, up to George III. himself— appeared in the 'Public Advertiser' of London from 1867 to 1772; ceasing with the dispersion of the party faction most liked by Francis, and a year before his great promotion and his departure from England. The case for his authorship is effectively put in Macaulay's 'Essay on Warren Hastings.' See JUNIUS.

Francis of Assisi, äs-se'ze, **Saint,** Italian founder of religious order: b. Assisi, Umbria, Italy, 1182; d. Assisi 4 Oct. 1226. St. Francis of Assisi is the founder of the Friars Minor, who are usually styled Franciscans (q.v.). His family name was Bernardone. At baptism he was called John. Whether it was because his father, who was a merchant, was at the time largely engaged in French trade, or because of the saint's own familiarity with the French language, the name Francis eventually superseded that of John. As a youth he was remarkable for his ardent piety and the spotless purity of his life, but is reproached with a worldly vanity in dress which his wealth enabled him to indulge in. A change of heart came over him in consequence of a year's confinement as a prisoner of war; a serious illness helping the transformation. He began to dispose of his property for the purpose of repairing dilapidated churches. Irritated by his extravagance his father treated him with the greatest cruelty; the trouble ending by the saint's abandonment of everything, even his worldly apparel, and he assumed the dress of a common laborer. His zeal for church restorations grew in intensity, and being no longer able to devote his own patrimony to the work he obtained the necessary means by begging; he himself laboring at the buildings with his own hands. His affection was lavished also on the poor and especially upon lepers. He lived in the extremest poverty, practised the greatest austerities, and for a time was looked upon as a madman. Distinguished and learned men, however, began to associate with him and follow his way of life. Though not a priest (and he never became one) he began to preach everywhere on the necessity of penance. As those were the days in which Barbarossa was raging against the Church, both religion and morality needed reformation, and the preacher was eagerly listened to by all classes. When the number of his followers increased, the desire to institute a new religious order developed, and for that purpose he betook himself to Rome, but Innocent III., then sovereign pontiff, treated the proposal with indignation. Francis persevered, and the request was granted. The new community, known first as the Preachers of Penance, increased with astonishing rapidity, and at the first general chapter more than 5,000 friars assembled; some from the humble classes of life, others already famous in Church and state. The foundation of the order coincided with the great Lateran Council, the spirit of which was against the formation of any new religious order. In spite of this, however, there seemed to be a tacit consent to allow the new movement to proceed. It was when Pope Honorius finally gave the necessary authorization that Francis met the Spanish canon Dominic, who was in Rome to found his own Order of Preachers, commonly known as Dominicans (q.v.). The two saints met in church and instinctively recognized each other, becoming immediately most devoted friends. The visions and miracles reported of Francis are bewildering in their number and character. In the hope of martyrdom he made several attempts to preach the gospel to the Mohammedans. His prayer and austerities were continued, his ecstasies frequent, and while on Mt. Alverno he received on his person what are known as the *stigmata,* namely, bleeding wounds on the hands, feet, and side, corresponding to the marks on the crucified body of the Saviour. Wherever he went he was honored as a saint; and his preaching was irresistible in its pathetic and stirring appeals to repentance. The rule of life he laid down for his followers was based on the strictest poverty, that is, no property, and dependence on the alms of the faithful. This extreme rigor almost immediately brought dissension in the order. Parties were formed, and the Friar General Elias, who had been appointed by Francis, was its bitterest opponent, going so far as to leave the order and to side with Barbarossa, who was then in open warfare with the Church. Nevertheless, the friars continued to increase in number and to spread everywhere, preaching the gospel and carrying the faith into distant countries. Besides his order for men, he established another for women, commonly known as the Poor Clares, so called from Saint Clare, the first superior. There is still another section called the Third Order of Saint Francis, for men and women living in the world, who follow a mitigated and adapted form of the rule of the friars. All three have given a vast number of saints and scholars to the Church. Francis died at the age of 45, 19 years after the establishment of his order. The extreme beauty, simplicity, and amiability, and perhaps the poetry, of the saint's character, but especially his love of created nature, have had the effect in our own days of developing a singular cult for him on the part of many outside the Catholic Church. The movement was started by Paul Sabatier, a French Calvinist minister, and Franciscan societies for the study of the life of the saint and of everything connected with him have been established in several countries of Europe.

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Thomas J. Campbell, S.J.

Francis de Sales, sälz, Fr. säl, **Saint,** French prelate, founder of the Order of Visitation: b. of a noble Savoyard family, in the château of Sales, near Geneva, 21 Aug. 1567; d. Lyons 28 Dec. 1622. He was educated by the Jesuits at Paris, studied law at Padua, and having a strong bent to theology and a religious life, entered the Church. Earnest and successful as a preacher, he was sent in 1594 with his kinsman, Louis de Sales, to preach in the duchy of Chablais, and bring back, if possible, to the Roman Catholic Church the followers of Calvin. He had a large measure of success. His conferences with Théodore de Bèze, Calvin's successor, at Geneva, were, however, without result. He went to Paris in 1602, preached there with great success, and steadily refused the offers of dignities made by the French king. The same year he was appointed bishop of Geneva, and taking St. Charles Borromeo as his model, applied himself zealously to the reform of the diocese and its monasteries. He was disinterested and free from worldly ambition, and declined the offer of a cardinal's hat and the renewed invitations of the king of France. In 1610 he founded the Order of the Visitation, of which the first directress was his friend, Madame de Chantal. His best known works are the 'Introduction to a Devout Life,' which has been translated into many languages, and 'A Treatise on the Love of God.' He was canonized by Pope Alexander VII. in 1665. See 'Life' by Camus.

Francis Xavier, zăv'ĭ-ėr, Fr. ksăv-ē-ā, **Saint,** Spanish Jesuit missionary: b. Castle of Xavier, Navarre, 7 April 1506; d. Island of Sancian 2 Dec. 1552. Saint Francis Xavier was born in Spain, of one of the noblest families of the kingdom of Navarre. After the usual collegiate studies in his own country, he went to Paris for a course of philosophy in the University. In spite of his extreme youth, his extraordinary ability secured for him a professorship in the affiliated College of Beauvais. It was in Paris that he met the man who shaped his destinies, Ignatius of Loyola (q.v.). Abandoning his professorship, he took up the study of theology, practised the rudest austerities, bound himself to a life of evangelical poverty, chastity, and obedience, and with Ignatius and five other companions established what is known as the Society of Jesus.

The original purpose of this organization was to evangelize Christians living in the Mohammedan countries of the East. Failing in that, they offered themselves to the Pope and were employed by him in most responsible trusts in various parts of Europe, which, however, they combined with labor in pest houses, prisons, and among the abandoned poor. A demand coming from John III. of Portugal for 10 missionaries to evangelize the new Portuguese possessions in India, Francis Xavier was chosen, but went alone, invested, however, with the dignity of Apostolic Nuncio, a dignity which he sedulously kept out of sight.

The day after the command was given to go he left Rome for Lisbon, making the journey on foot, preaching and teaching on the way. In Portugal his influence was so instantaneous and so great that the king purposed to keep him in his dominions. But nevertheless Xavier set sail for the East, 7 April 1541, having refused even to see his own relatives before leaving. The journey meant more than a year of great sufferings, and he reached Goa only on 6 May 1542. The ignorance and immorality which prevailed there were deplorable and a complete and immediate revolution in conditions followed his arrival.

Then began his series of amazing apostolic journeys. They can only be appreciated by recalling the methods of travel of those days; the perilous character of the seas through which he continually sailed, and the savage or barbarous nature of the people he had to evangelize. From Goa he went around Cape Comorin and Ceylon, then back to Goa again, then through every principality of Hindustan, off through the scattered islands of the coasts, until he reached the distant Moluccas; establishing missions everywhere, and managing all the complicated and multiplied works which necessarily resulted. The story of his life is simply a series of surprising evangelical conquests, bringing thousands to Christianity by the efficacy of his preaching, the prodigies he wrought, and the extraordinary sanctity of his life.

On 15 Aug. 1549 he reached Japan. He remained there only two years and four months, but succeeded in penetrating almost all the little kingdoms into which the country was then divided; breaking down the opposition of the Bonzes who were the chief enemies of the Gospel, winning vast numbers to the faith, and establishing his followers in the favor of both rulers and people. The sway which he exerted over the Japanese mind may be inferred from the reverence with which he is still regarded there. The thoroughness with which he and his successors taught Christianity is evidenced by the fact that 25,000 Catholics were found in Japan after three centuries of persecution. They had handed down the faith from father to son without any ecclesiastical ministrations.

To obtain laborers for this new field he returned to Goa in 1551. We then find him venturing on a new project, attempting to win China to Christianity. Its conversion he thought essential for the maintenance of the faith both of India and Japan; for the corrupting influences in both those places he considered to be largely due to their relationship with China. He never reached that country but died on the Island of Sancian, about six leagues from Canton, being only 46 years of age. This last fatal voyage had lasted nine months.

His entire apostolate in the East extended over only 10 years, but he is said to have planted the faith in 52 kingdoms, preached the Gospel through 9,000 miles of territory, and baptized more than 1,000,000 persons. Fifty years after his death Pope Paul V. by a bull, dated 25 Oct. 1605, declared him blessed, and, 16 years subsequently, Gregory XV. canonized him, but on account of the pontiff's death, which occurred just at that time, the bull of canonization was issued by Urban VIII. on 6 Aug. 1623. He is honored in the Church on 3 December and is usually styled "the Apostle of the Indies." The devotion to him is universal and countless churches are erected under his invocation. His relics are still preserved in Goa, and in 1859 the body was found to be incorrupt.

Bibliography.— Bartoli, 'Life of St. Francis Xavier'; Bouhours, 'Life of St. Francis Xavier'; Coleridge, 'Life and Letters'; B. N., 'History of the Society of Jesus'; Cretineau-Joly, 'History of the Society of Jesus.'

THOMAS J. CAMPBELL, S.J.

Francis'cans, the designation borne by the members of the three great religious orders founded in the 13th century by St. Francis of Assisi. The first of these orders is that of the Friars Minor, known as the Greyfriars, and in France as the Cordeliers. The second order is that of the Poor Clares, called in Italian *Povere Donne* (Poor Ladies), and in France the Clarisses. The third order is that of Penance, or Tertiaries.

1. Francis, keenly alive to the evils which in his day seemed to threaten the very existence of the Church and society, strove to counteract their baneful influence by establishing an order, the members of which were to observe the most absolute poverty, and to be devoted to the service of the Church. The goal which he aimed at was to reproduce the ideal of the divine life on earth, therefore neither he nor his were to possess anything temporal, but were to go about doing good and preaching to all the world the kingdom of heaven. A little band of disciples to the number of seven, aglow with enthusiasm, gathered around the saint, and the little chapel of Sta. Maria degli Angeli, near Assisi, which he called Portiuncula, "the little portion, or inheritance," was the place where the order was first planned. It was truly a humble origin, an insignificant beginning, but Francis had a presentiment of the future world-wide extension of his order. In 1210 he obtained from Innocent III. a verbal approbation of the rule he had drawn up for it. Forthwith it appeared how accurately he had gauged the wants of his age, for his order sprang at a bound into popular favor. So rapid was its growth that 10 years afterward at a chapter held near Assisi, more than 5,000 of his religious assembled, and not half a century had elapsed when they counted missionaries in every known country, as may be learned from a bull of Alexander IV. in 1258. In 1260, when a chapter presided over by St. Bonaventure was held at Narbonne, the order had 1,400 houses. At the dissolution of the monasteries in England there were 65 houses of Franciscans, and even in 1680, in spite of severe losses in Protestant countries, the order numbered 100,000 members. The order is ruled by a general minister, who, with his council or *definitorium*, resides in Rome. It is divided into provinces to govern which provincials are elected. Each province is composed of a certain number of houses or convents, whose superiors are termed guardians.

Owing to the absolute nature of the poverty prescribed by the second rule drawn up for the first order and approved by Honorius III. in 1223, some of St. Francis' immediate followers showed tendencies inimical to it even in the saint's lifetime. After his death these tendencies became more marked, and were covertly connived at and effectively encouraged by the second minister-general, Elias of Cortona. This was the rift in the lute which widened as time went on. Some zealous upholders of the purity of the rule, such as St. Anthony of Padua, Adam de Marisco, Cæsar of Spires, protested against all innovations, and labored strenuously to maintain intact their sacred inheritance, receiving the distinctive name of Cesarines, but eventually returning to the body of the order in 1256. Other reforms were initiated, such as that of Peter of Macerata, 1294; that of Philip of Majorca, 1308; that of John of Vallées, 1336; and others. They met with varying success, until in 1415 a final split took place, one section of the order adopting the mitigations which had been introduced in the matter of poverty, this being the bone of contention all through. They became known as the Conventuals, while the members of the other section were called Observants, as observing faithfully the Franciscan traditions. These latter still adhere strictly to the original austerity of their rule. St. Bernardine of Sienna, St. John Capistran, and St. James de la Marcha were mainly instrumental in promoting the interests of the Observance. In 1517 Leo X. issued his famous bull, *Ite et vos in vineam meam,* decreeing that a general minister of the whole order was to be chosen from among the Observants, and that the Conventuals were to elect a master-general. The Observants, however, did not satisfy the zeal of some, and thus we find certain groups, such as the Reformati, originating in Italy; the Alcantarines, or those who follow the reform of St. Peter of Alcantara, in Spain; and the Recollects.

There were now the two great families of the first order, the Observants and the Conventuals, these latter being governed, as said above, by a master-general, and notwithstanding their dispensations in regard to poverty, they have always rendered important services to the Church. The great Pope Sixtus V. was himself a Conventual.

In 1525 there arose a third family, known as the Capuchins (q.v.).

The Franciscans did not devote themselves exclusively to the apostolic life. From the first they took an active and leading part in the study of Holy Scripture and in all the branches of sacred and secular learning. They have filled with honor the first chairs in the most celebrated universities. Such great names occur among them as Alexander of Hales, St. Bonaventure ("the Seraphic Doctor"), Blessed John Duns Scotus, called "the Subtle Doctor," who as defender of the Immaculate Conception became the leader of the Franciscan school, Francis Mayronis, and Nicholas de Lyre. In England during the centuries immediately preceding the Reformation, there were 67 friars professors at Oxford and 73 at Cambridge, among them being Adam de Marisco, Duns Scotus, Roger Bacon, the pioneer of the modern discoveries in the physical sciences. Thomas de Celano, who wrote 'Dies Iræ,' and Jacopone da Todi, author of 'Stabat Mater,' were Franciscans. Nuncios, legates, archbishops, 50 cardinals, and 5 popes have been chosen from among the Franciscans.

The relations of the Franciscans with America began with its very discovery. Father Juan Perez, guardian of the Franciscan monastery at La Rabida, the adviser and personal friend of Columbus, with several companions, accompanied the discoverer in 1493. The first convent was erected for them at what is now the city of Santo Domingo, on Haiti; another arose at La Vega, on the same island. Connected with these convents were the first schools in the western hemisphere.

Owing to the enthusiasm among the religious in Spain, and to the docility of the Indians, the order spread so rapidly in the West Indies that King Ferdinand found it advisable to issue a decree forbidding the erection of a new convent except at a distance of at least five leagues from one already existing. In 1505, only 13 years after the discovery, there was a sufficient number of convents to form a province, under the name of Holy Cross. The first diocese to be erected was Santo Domingo, in 1504; its first bishop was Father Juan de Padilla, a Franciscan.

After the Spaniards had set foot on the mainland, the king, ever anxious for the spiritual welfare of the aborigines, sent over a great number of friars under the leadership of Father Juan de Quevedo, who was appointed bishop of Darien, the first bishop on the American continent. The Franciscans entered Venezuela in 1508, Brazil in 1519; in 1535 they were able to form a province in Peru, whence were founded the missions farther south in the Andes and Pampas. Saint Francis Solanus, called the Apostle of Peru on account of his extraordinary missionary labors, evangelized these regions; he died at Lima in 1610.

In 1521, if not before, the first Franciscans came to Mexico. Together with 12 friars known as the Twelve Apostles of Mexico, there labored here from 1533 to 1572 the famous Brother Gante. He wrote a catechism in the Aztec language, erected over 100 churches, and with one companion frequently baptized 8,000 Indians in one day. Many schools were erected, in which often as many as 600 and 800 boys received an elementary education. Owing to their stainless lives, abstinences, and contempt for gold, the friars obtained marvelous results among the natives. In 1535 the 70 convents in Mexico were organized into a province. At the end of the 16th century there were three provinces; others have been formed since then, besides several missionary colleges, whence zealous missionaries set out to convert the natives to the north, notably in Florida, New Mexico, Arizona, Texas, and California.

Florida was the first of the States that beheld the Franciscan garb. Five friars came with Narvaez in 1528; their superior, Father Juan Suarez, was the first bishop in the United States. In the course of time the missionaries succeeded, though not without heavy sacrifices of life and labor, in establishing flourishing missions all along the coast and in the interior as far west as Mississippi and as far north as Georgia. In 1634 there were 34 friars, who maintained 44 mission stations, where they attended to about 30,000 converts. These missions suffered greatly by invasions from Carolina and Georgia, and when Florida was ceded to the English in 1763 they ceased to exist.

Arizona and New Mexico were first visited by Franciscans in 1539; in the course of time a great many missions and churches were established, to most of which were attached schools for boys, as we learn from an official report of 1632. Beginning with 1689, about 160 friars labored in Texas up to the time of the Mexican independence, when the missions were ruined.

The Franciscans came to California in 1768 under the renowned Father Junipero Serra. The first mission founded was San Diego. Up to 1823, 21 missions were organized, forming a chain which extended a distance of over 700 miles. At the height of mission prosperity 30,000 Indians lived under the paternal guidance of the friars; they were fed, clothed, and educated, with no expense to the government, the missions supporting themselves by agriculture and stock-raising; everything was manufactured at these establishments by the Indians. In 1834 the Mexican government began to confiscate the missions and took them from the control of the friars; this work was finished by 1846 and brought about the complete destruction of the once so flourishing missions.

While the Spanish Franciscans were thus extending their labors in the south from the Atlantic to the Pacific, other bands of Friars Minor were emulating their example in the north. Champlain induced the French Franciscans, formerly called Recollects, to come to Canada as early as 1615. Thence they penetrated into Maine, New York, Pennsylvania, Michigan, Illinois, Minnesota, and Wisconsin. The best known of these missionaries is Father Louis Hennepin. He accompanied La Salle on his expeditions, and was the first to publish a description of the Niagara Falls. While a captive among the Sioux he saw and named the Falls of Saint Anthony. About this time we find the English Franciscans laboring in Maryland and adjoining colonies for full half a century. In the beginning of the 19th century the Rt. Rev. Michael Egan, a Franciscan and first bishop of Philadelphia, intended establishing a province of his order in Pennsylvania, but he died before accomplishing his design. In 1845 Franciscans from the Tyrol came to Cincinnati; in 1854 Italian friars formed a community in western New York, and in 1858 German friars settled in Illinois. The «Kulturkampf» was the cause of many more coming to the United States.

At present there are in the States about 1,200 Franciscans, who are distributed as follows: The Custody of the Immaculate Conception (New York city) in the Eastern States has 8 houses, with 37 members; the Province of the Holy Name (Paterson, N. J.), also in the Eastern States, has 12 houses, with 132 members; the Province of Saint John the Baptist (Cincinnati, Ohio), chiefly in the Central States, has 33 houses, with 343 members; the Province of the Sacred Heart (Saint Louis, Mo.), in the Central and Northern States, has, including the houses in California and Arizona and the Polish communities in Wisconsin, 44 houses, with 521 members. Most of these friars are engaged in regular parish work; some preach missions throughout the States; others are on the Indian missions in Michigan, Wisconsin, California, Arizona, and New Mexico. They also conduct one seminary (Allegany, N. Y.) and six colleges (Allegany, N. Y., Cincinnati, Ohio, Teutopolis, Ill., Quincy, Ill., Pulaski, Wis, Santa Barbara, Cal.).

The Conventual Friars Minor came to the United States in 1851, and at present form a province in New York and New Jersey numbering about 125 members. Besides these there are in the States 134 Franciscan Brothers and some 7,800 Sisters, all belonging to the third Order of Saint Francis. In 1897 the four above-mentioned groups, namely, Observants, Reformati, Alcantarines, and Recollects, who had always been under the same minister-general, dropped their distinctive traits and are now known simply as Friars Minor or Franciscans. They number at present 17,500, are distributed into 77 provinces, and have 1,500 houses. In 1893 the Conventuals numbered 1,462, which number has since decreased, and had 172 houses.

Consult: Shea, ‘Catholic Church in the U. S.’; Hammer, ‘The Franciscans in America’; Engelhardt, ‘Franciscans in California’; ‘Franciscans in Arizona.’

Rev. P. Hugoline Storff, O.F.M.

Franck, César Auguste Jean Guillaume Hubert, sā'zar ō-güst zhŏṅ gē-yōm übär, fränk, French composer: b. Liège 1822: d. Paris 1890. He studied in the conservatory of his native town and at Paris, and in 1872 succeeded his master, Benoist, as teacher in the Metropolitan Conservatory. His talent as a composer was for a long time unrecognized, and in 1846 his oratorio ‘Ruth’ fell flat. Twenty years later it was revived and created a furore, and Franck found himself leader of a new school. The popularity which his works still enjoy at Paris has to some extent spread to the United States, where his oratorio ‘Les Beatitudes’ has been much appreciated.

Francke, August Hermann, ow'goost hĕr'-män frän'kė, German Lutheran clergyman and philanthropist: b. Lübeck 22 March 1663; d. Halle 8 June 1727. In 1692 he obtained the professorship of Oriental languages at Halle, which in 1698 he exchanged for that of theology. A pupil of Spener and the teacher of Zinzendorf, Francke belonged to the ranks of those who carried forward the pietistic movement; his activity, however, took the practical direction of founding, endowing, and organizing various educational institutions at Halle. Among these were a school for the poor, a pædagogium, a burgher school, a Latin school, and a seminary for training teachers for these establishments, all founded in one year, 1695; and with them was associated an orphanage, which became in the course of time the most important of all Francke's institutions. At the time of his death his schools were frequented by more than 2,300 pupils. Francke's principal aim was religious instruction, but he founded also a printing-office, and an apothecary's shop, and taught natural science and physical exercises and manual trades. At the present time all Francke's foundations exist with but little alteration; in addition to those mentioned there are also a real-gymnasium, two schools for girls, and a free school. The number of pupils is more than 3,000 annually. See ‘Lives’ by Kramer (2d ed. 1885); Stein (2d ed. 1886).

Francke, Kuno, American educator: b. Schleswig, Germany, 27 Sept. 1855. Was educated at Kiel; came to the United States and has been professor of German literature in Harvard University for many years. His notable book ‘Social Forces in German Literature’ appeared in 1896; followed by ‘Glimpses of Modern German Culture’ (1898); ‘History of German Literature’ (1901); etc.

Francken, Frans, fräns fränk'ĕn (called The Younger), Flemish painter: b. Antwerp May 1581; d. there 6 May 1642. After a trip to Italy he was received into the Guild of St. Luke at Antwerp, where he worked at first in the brilliant colors of the old masters and later in the realistic style of Rubens. Most prominent European galleries have examples of his art.

Francken, Frans (called The Third), Flemish painter: b. Antwerp 1607; d. there 2 Sept. 1667. He was admitted to the Guild of Saint Luke in 1639. His works, patterned after Rubens, are unsigned and therefore difficult of identification. Specimens of his religious subjects are to be seen at Augsburg (‘Moses Striking Water from the Rock’) and Vienna.

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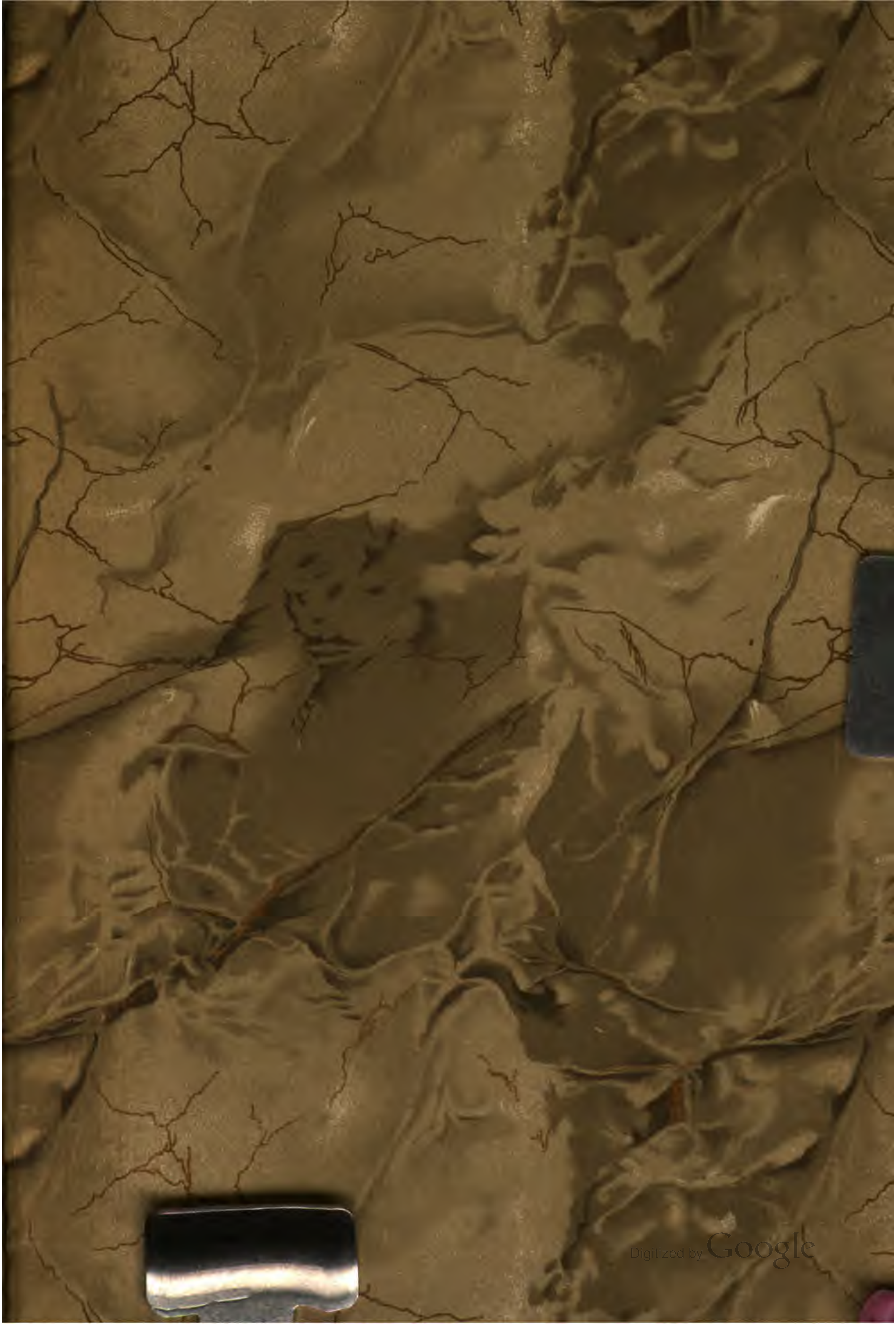

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